

“LET THERE BE LIGHT”
-
LEAVING NETHERWORLD

Sam S. Abujawdeh
June 2015

“E PLURIBUS UNUM”

DEDICATED TO MY CHILDREN,
MINERVA, SAMMY, SANDRA AND
JENNIFER,
WHO **ARE** THE LIGHT OF MY WORLD



Fourth Edition – Colonia, New Jersey 2015

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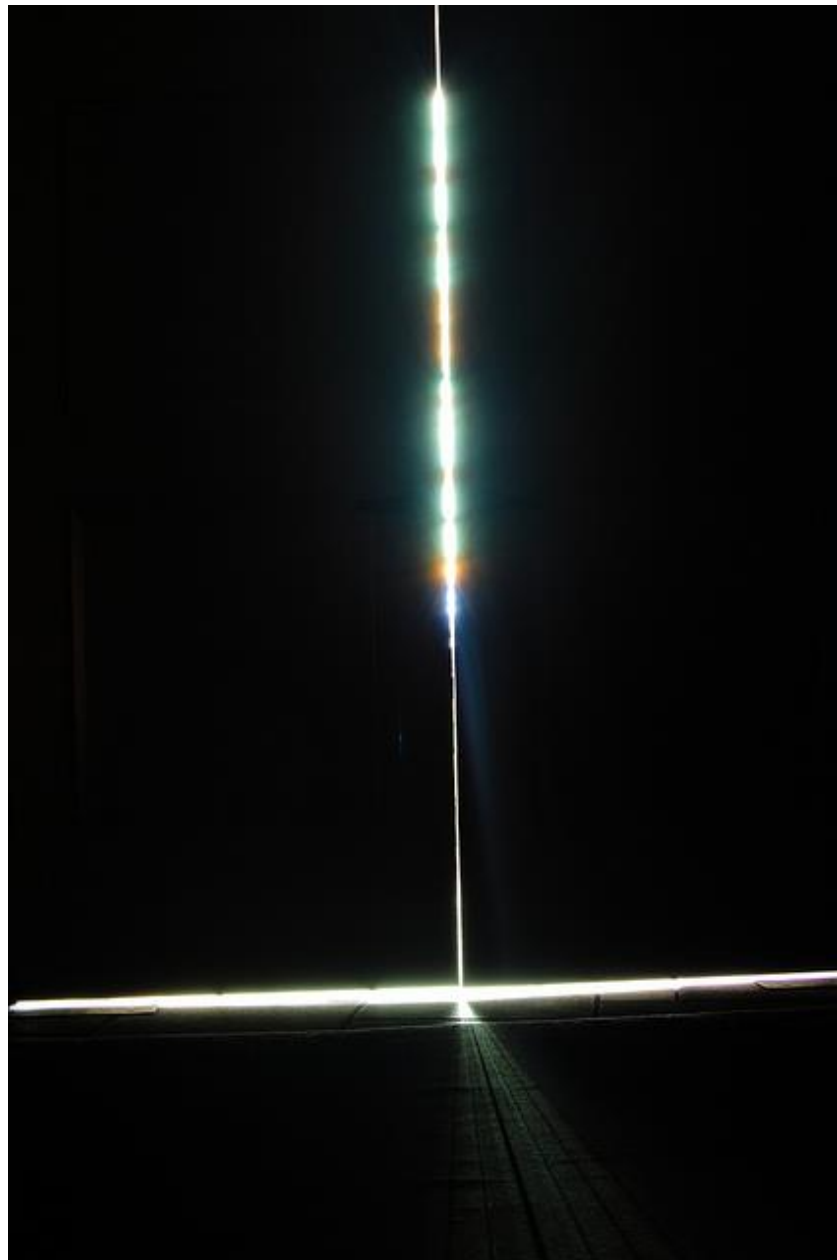
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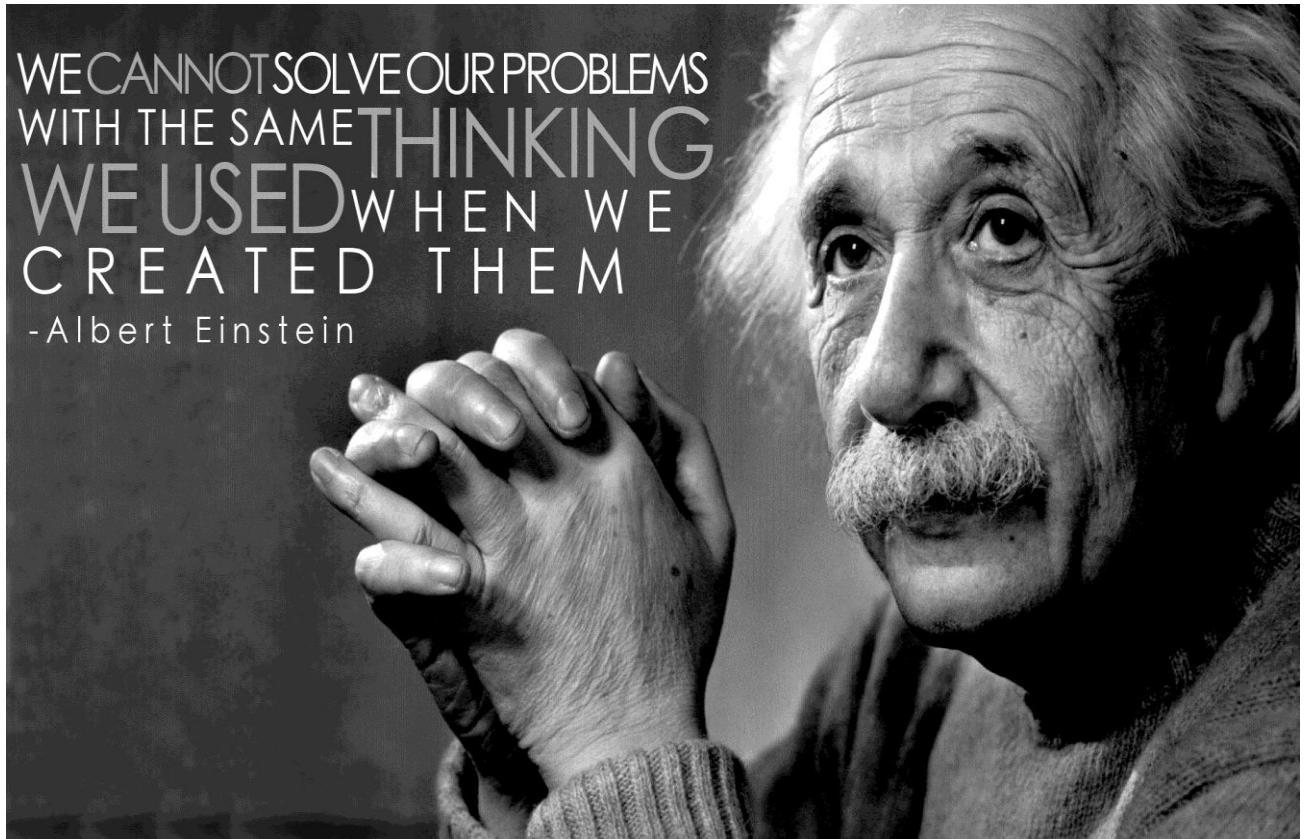
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WE CANNOT SOLVE OUR PROBLEMS
WITH THE SAME THINKING
WE USED WHEN WE
CREATED THEM
-Albert Einstein



"If you think you understand quantum mechanics, you don't understand quantum mechanics."

"'Paradox' is only a conflict between reality and your feeling of what reality 'ought to be.'"

"It is very important that we do not all follow the same fashion ... It's necessary to increase the amount of variety ... the only way to do it is to implore you few guys to take a risk ..."

Richard Feynman

"Anyone who is not shocked by quantum theory has not understood it."

Niels Bohr

"The only laws of matter are those which our minds must fabricate, and the only laws of mind are fabricated for it by matter."

J. C. Maxwell

PROLOGUE

We know a lot.

Hundreds and thousands of very sharp people have been working hard over the centuries solving many of science's mysteries. They have done a magnificent job, not often appreciated, and not often understood. They have succeeded in baring Nature's plan in all its aspects. We have went from "the (magnetic) loadstone is alive and iron is its food" to the Feynman diagrams of QED. You can see the jigsaw puzzle filling out, with a few holes here and there, but the picture is pretty clear.

I have tried to learn what has already been gleaned, from textbooks, popular scientific retellings and, significantly, from reading the originals and the history of the development of the sciences – Faraday wisely advised his students *"to read the original memoirs on that subject, for science is always most completely assimilated when it is in its nascent state"*. I have not yet, of course, crossed the Landau barrier. As the Germans say, I know "nothing about everything".

But one thing I did learn: When it comes to the ultimate basics, the foundations of space, time, quantum & relativity, we do not KNOW what is going on. Sure, there are a lot of ideas – some comprehensive but unproven (like String Theory), some half-baked narrow proposals, but nobody knows. Google the speed of light, and you will find hundreds of opinions arrayed on both sides whether it is constant or just seems so. Mention non-locality, and you either get glazed eyes, or high-level talk about complementarity and how "the equations of the wavefunction require it". Discuss reality (or even the measurement collapse problem in Quantum Mechanics) and you get a hundred unproven suggestions, with no solution in sight. Read the minutes of the prestigious Solvey conferences, and you find more questions than answers. I learnt basically that I was not alone in my ignorance, and in my curiosity.

What follows is a humble proposal for an elementary vision of the makings of the physical world, this world we know so much and yet so little about. It addresses the basics, the initial conditions, the beginnings– one of the "holes"

in our knowledge. It is potentially deluded, but so most new ideas seem. It is, however, linked to a long tradition of ideas about creation and existence, and consistent with our modern view. The basic ideas are exposed, with much detail still awaiting to be expounded. Thrown in also a couple of insights developed along the way, threads of thought yet to be followed.

I wrote this book mostly for me, and I suspect that will be its readership ☺. I wanted to put together the ideas that grew in my mind – my personal paradigm- from reading hundreds of books and articles on the various subjects, so that I at least can have a clear picture in my head about how this whole Shebang is put together. In researching those ideas, I found many like-minded travelers, with somewhat similar ideas, and have tried to reference their work where I could. Many are from the solid halls of academia, but many are also considered “outsiders”, or at least not mainstream. I was surprised and dismayed at the level of political correctness and rail-roading displayed by the science community towards those that do not tow the main line – from quantum orthodoxy (a religious term incidentally), to String hegemony, and even relativity stalwarts (something I am sure would have annoyed Einstein). True, some of the ideas and some of their proponents are “out there”, and may be justifiably labeled pseudo-scientists, but the majority are honest enquirers, not satisfied with the “its just so” explanations. I would like to think Einstein, Feynman and many other innovators were of this last sort. I surely hope I am not of the first sort, although we are poor judges of our own selves. One thing I am sure of: my idea is less Crazy than the Many-Worlds theories many leading scientists support ☺.

Experience informs intuition. But as the Twentieth Century scientific revolutions of Relativity and Quantum Mechanics have shown us, experience can mislead our intuition as well. Asking “meaningless questions” like EPR can open a new path. Sometimes a raw “Happy Thought” is what it takes to make a break-through.

The idea invites comments, eagerly awaited for the sequel.

Sam S. Abujawdeh
June 2015, Colonia, NJ

ACKNOWLEDGEMENTS

This work is a summary of experiences and learnings over a lifetime, enriched by friendships and relations that have made it interesting and made this writing worthwhile.

Special thanks go to my family, whose lives and love recreate new worlds for me every day.

Thanks to my teachers – Mr Elias Butros, who first got me interested in Physics; Mr Emile Sawaya, whose humor taught us Chemistry; Mr Topolian and Mr Hoss who taught me mathematics while making it fun; Dr Howard Card who taught me Electrical Engineering; Dr Kent who gave me the first taste of Quantum Mechanics; the irascible Dr Joel Weisman who could weave magic out of Physics, and made it all come together.

Thanks to the Army of Civilization, the scientists and artists whose contributions have made our lives the enlightened pleasure it is, instead of the brutal struggle it started as. A special salute to my two scientific heroes, Einstein and Feynman, who combined genius with wit and humor, and made Science a Pleasure as well as a Treasure.

And thanks to the Internet and those who made this infinite Library possible. A word of thanks is due also to some of the visionaries who are helping keep this treasury alive and preserved- the Google archives who have copied millions of old books and placed them online, imitated and augmented by many other sites (Gutenberg, France's Gallica, etc.), who have put the world's library and treasures at hand for all to peruse and enjoy.

Special thanks go to my daughters Sandra, Jennifer, and Eva, who patiently read and edited most of the text, and encouraged the venture with their kind remarks.

Any foolishness remaining is of course entirely my own ☺.

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ABSTRACT

A view is proposed of a Universe constructed as follows:

- A single elementary “particle” building block, tentatively called “Proto-Light” (PL), a *LOGICAL* entity in a logical Hilbert space created ex-nihilo from the void/chaos.
- A Pre-geometrical relationship process between these PLs leads to the creation of an emergent space and time. The interacting nodes create “trees” whose inter-connections coalesce into the 3-D space we observe. Multiple approaches to this pre-geometry are discussed, leading to the realization of Wheeler’s it-from-bit concept.
- A super-fluid Universe created from these multiple PL instances affords the evolution and emergence of most of our current science, including the Standard Model, Quantum Mechanics, and Relativity. Analogies to He3 superfluids indicate the validity of such a concept.
- The detritus of the 3-D space formation, being isolated space-time patches (wormholes) and unlinked trees, are responsible for the probabilities of Quantum Mechanics and its non-local behavior. A “Patchwork” Universe explains the “measurement” problem and entanglement.
- EM radiation (photons, and color photons (gluons)) is seen as PL Clusters (PLCs) configured in additional dimensions of the Hilbert Space. They travel at the speed of light on the “Highway” of the emanent 3-D mesh, and by the nature of their interactions, provide the aspects of Special Relativity.
- Matter is seen also as made of PLCs, being essentially “looped” photons. Anti-matter is seen as made of anti-PLs, negative energy matter (original conception of Dirac & others), while radiation is a matter/antimatter oscillation. Mass is a derived concept from the kinematics of PLC motion. The idea of the electron as a photon loop is explored, including possible high-limits on EM energy waves, and photon length/duration calculations.
- Special Relativity is seen from a Lorentzian perspective, and is demonstrated to be equivalent (a-la- John Bell) to Einstein’s view. The Superfluid PL ocean is seen as the new Ether, which does not contradict SR’s principles or results. Possible superluminal effects are discussed.

- Bohm's & De Broglie's Guiding wave concept is elaborated as actual PL Pilot waves, providing linkage to QM's results and an ontology for QM, justifying the particle-wave duality.
- The Reality/Measurement conundrum of QM is explained by isolated space-time patch events versus the correlated macroworld.
- Dark Energy is explained as the 3-D PL sheet, with those PLs providing its "energy". Continuous creation and growth of the PL sheet explains the expansion of the Universe and the cosmological constant. Dark Matter is also explained as 3-D higher density PL effects in resonance with matter and Pilot waves.
- Similar ideas and concepts that have been proposed are explored. The idea of a Mathematical Universe is suggested, with the "Universe as a big quantum computer, running the biggest possible game to generate our reality" (Vedral).

We explore "the 'surface geology' and 'underground geology'" of our world, to paraphrase the genius of Wheeler. The result is a conceptual model, largely qualitative, that fits in with many current ideas of the pre-geometry of space and time, Super-fluid Ether models, QM, and modern cosmological models, while presenting a possible "picture" and ontology for the overall scheme.

Each of the ideas supporting the model have been studied by others in one context or another, with working proposals and supporting mathematics, at the periphery of academia at times, but also by many leading lights. The model brings their work together into a coherent whole and a new world-view.

It is a model that owes much to Einstein's dream of a "realistic" unified theory of nature, and Wheeler's incredible foresights. It could be Heisenberg's "fifth set" (after Newton's dynamics, Thermodynamics and statistical mechanics, Electrodynamics, and Quantum Mechanics), which he expected to "be found someday in connection with the theory of elementary particles".

1- PROTO-LIGHT

A theory is a mathematical description of our world, that attempts to emulate Nature, to replicate Nature's ways.

But many theories can often describe the same behavior of Nature successfully. The equations of Special Relativity were already written by Lorentz and Fitzgerald before Einstein dipped into the well. And when Einstein was done, his equations were almost exactly the same as theirs. But when we want to praise a man's genius, we don't call him a Fitzgerald. We call him an Einstein. What gives?

What Einstein did was see the whole picture. He saw the simple in the complex, and he saw the "idea" of relativity. And he described it so beautifully in a short paper, that today, 100 years later, still describes the essence of the theory, unscathed by time.

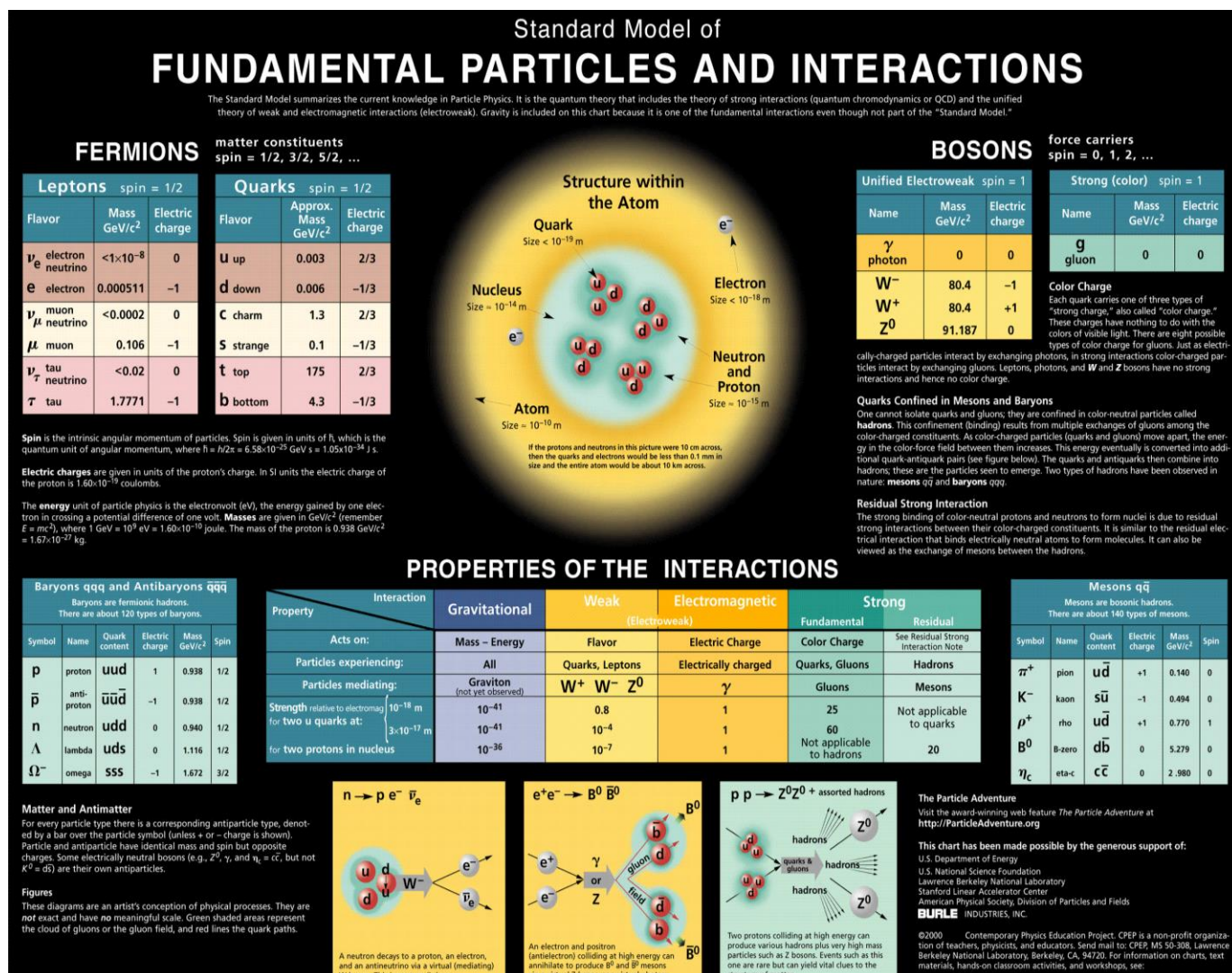
It is often the "vision" that makes a great theory. The ability to "visualize" Nature, sneaking a peak at its mysteries, and being able to describe it later, in a Gedanken Experiment, or a simple picture. It is the right interpretation that brings us closer to the truth, without which we are left groping in the dark, even when our results match the experiments. Quantum theory matches the experiments to an astonishing degree, but nobody understands it. We don't get the picture. Some otherwise very smart people keep telling us we do not need, and should not even be looking for the picture!

The interpretation is as important as the equation. Many of Nature's secrets can be explained in several ways, equivalent in various ways. The picture that sticks is the one that our minds can "see", the one that escapes Occam's Razor, the one that reveals Nature's simplicity and beauty. If we are momentarily unable to find the "right" interpretation (as seems the case perhaps with Quantum Mechanics), it would still be, in the words of Al-Khalili, "too arrogant for us to claim that since we are unable to choose, then neither does Nature."

This book is about a simple picture of the world. It is a basic idea, that can be developed and grown to encompass Science's current state. It is not an "additional" theory, but a picture that builds to existing theories. It is an attempt to make the world simple again.

1.1 - OUR WORLD VIEW

“Quantum Mechanics is the weirdest invention of mankind, but also one of the most beautiful. And the beauty of the mathematics underlying the quantum theory implies that we have found something very significant.” – Anton Zeilinger



Science, as we well know, has progressed significantly since Newton tried to find “a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered” before him. Around the end of the 19th Century, many (Lord Kelvin included) thought that all was in order, and the only thing left was some I’s to be dotted and T’s to be crossed. They were wrong of course, but the 20th Century filled a lot of gaps.

As Dirac said, between Quantum theory, Relativity, and later the Standard Model, we basically understand all of Chemistry and most of Physics. The

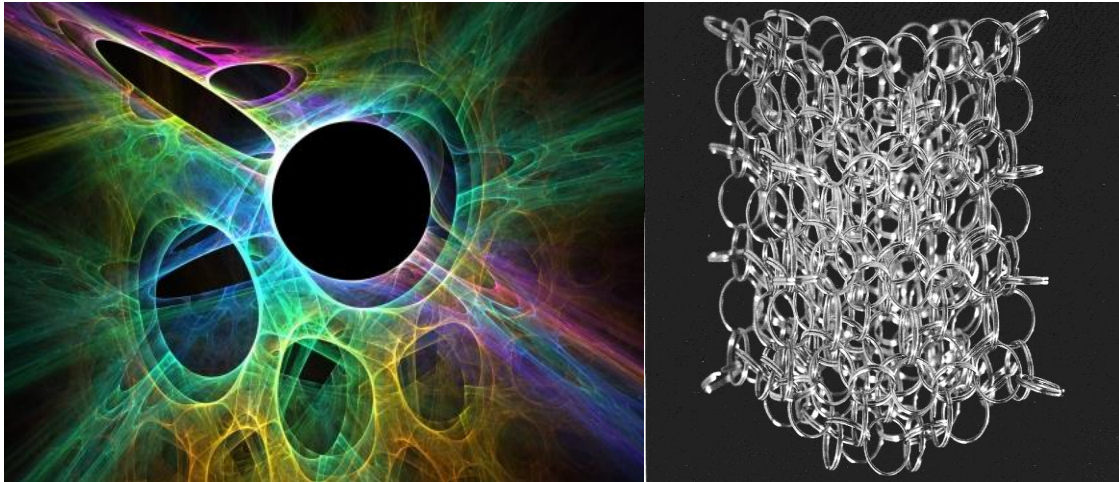
successes of QED (Quantum Electrodynamics), QFD (Quantum Flavor Dynamics), Standard Cosmology (Big Bang and Inflation), QCD (Quantum Chromo-Dynamics), and Quantum Mechanics have explained our world in much detail, to unimaginable accuracies. These successful models will likely not change much – like Newton’s laws, they may get a facelift, but their usefulness in all aspects of chemistry, biology, astrophysics, and our technology makes them proven “kernels” of any future enhanced theory. Any new theory must have them as a limit, if it is to survive the test of Nature.

The missing part in Physics is the root, the cause, the mysteries of the Quantum and the nature of reality. It is a meta-physical loss- the equations work pretty well, and we can do a lot with them, but the need for understanding the source remains. “I want to know God’s thoughts”, Einstein mused.

Periodic Table of the Elements

Group	1	2											13	14	15	16	17	18																														
	1A	2A											3A	4A	5A	6A	7A	8A																														
1	1 H Hydrogen 1.0078																	2 He Helium 4.0026																														
2	3 Li Lithium 6.938	4 Be Beryllium 9.0122											5 B Boron 10.806	6 C Carbon 12.009	7 N Nitrogen 14.006	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180																														
3	11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982	14 Si Silicon 28.084	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.446	18 Ar Argon 39.948																																								
4	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.63	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798																														
5	37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.9062	44 Ru Ruthenium 101.07	45 Rh Rhodium 101.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29																														
6	55 Cs Cesium 132.91	56 Ba Barium 137.33			72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)																													
7	87 Fr Francium (223)	88 Ra Radium (226)			104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (268)	111 Rg Roentgenium (268)	112 Cn Copernicium (284)	113 Uut Ununtrium (284)	114 Fl Flerovium (284)	115 Uup Ununpentium (288)	116 Lv Livermorium (288)	117 Uus Ununseptium (288)	118 Uuo Ununoctium (288)																													
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String Theory hasn't panned out, and we may soon cut that string. Quantum Loop Gravity has an approach still in progress. Many other ideas have been floated. There is certainly room for new ideas.



This proposal aims at a picture of the “Source”, the root of reality. It will only be developed to the point where we get the infrastructure of modern Physics, and modern Physics takes it from there. The proposal is light on Mathematics—partly a personal inadequacy, but also a large undertaking, requiring cooperation and Modeling resources, hopefully forthcoming. The general principles, however, are related with the goal in mind, and applied to the base mysteries for a clue and confirmation.



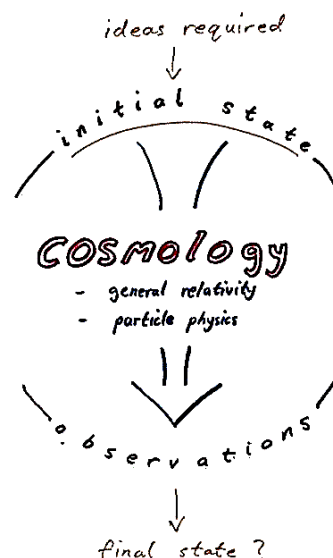
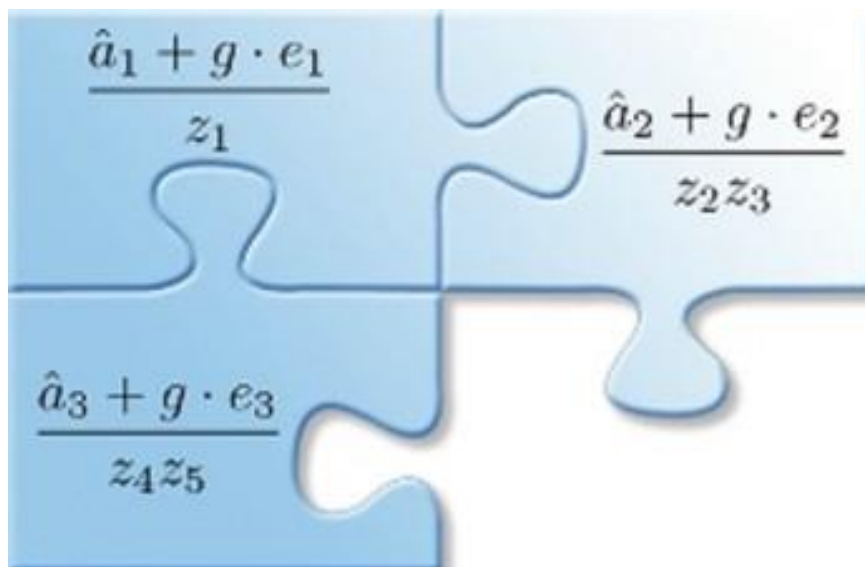
The Solution, I believe, starts with Light, the quintessence.

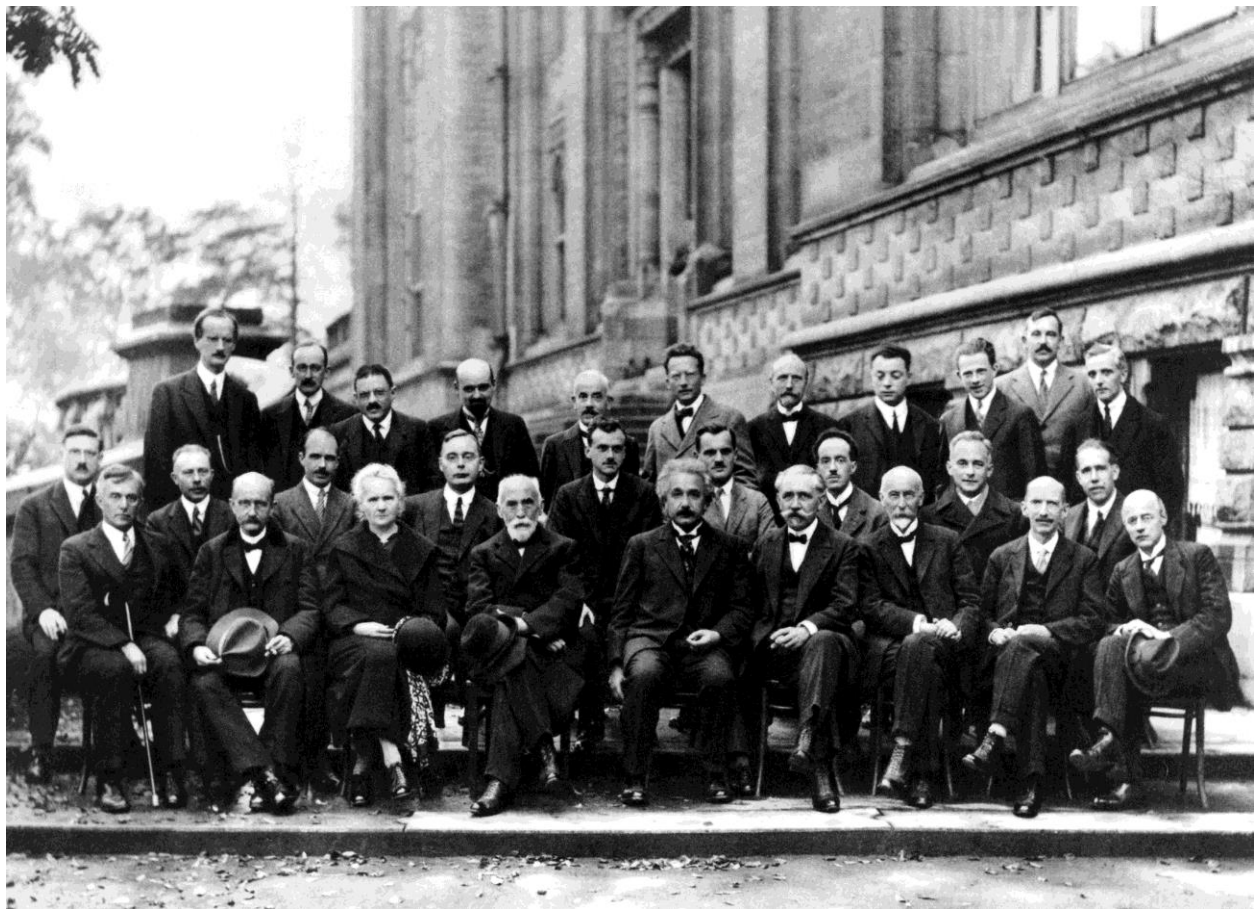
So how to define light? As a wave or as a particle? And what does it mean for a particle to have a frequency? And how come the energy of this packet is $E=h\nu$, ν being the frequency, and h the famous Planck constant? And how does matter and the rest of Physics tie into this?

Feynman said that Science is “imagination in a straight-jacket”. In the following, the jacket won’t be fully buttoned... Imagination will have a freer rein, but will also be dressed with the clothes science has woven over the centuries. But it will give us a physical understanding, something Feynman called “a completely unmathematical, imprecise, and inexact thing, but absolutely necessary”. As Krauss smartly reminds us, “What is often under-appreciated about science is that almost all of the ideas it proposes turn out to be wrong”, but that is how the road is ploughed for the right idea to come along.

Einstein mused whether “God could have made the Universe in a different way; that is, whether the necessity of logical simplicity leaves any freedom at all.” John Wheeler, that inspiring genius that shepherded many a Nobel Prize winner, said: “Some principle uniquely right and uniquely simple must, when one knows it, be also so obvious that it is clear that the Universe is built, and must be built, in such and such a way and that it could not possibly be otherwise”.

Well, let us try the following simple idea- it just may be right.



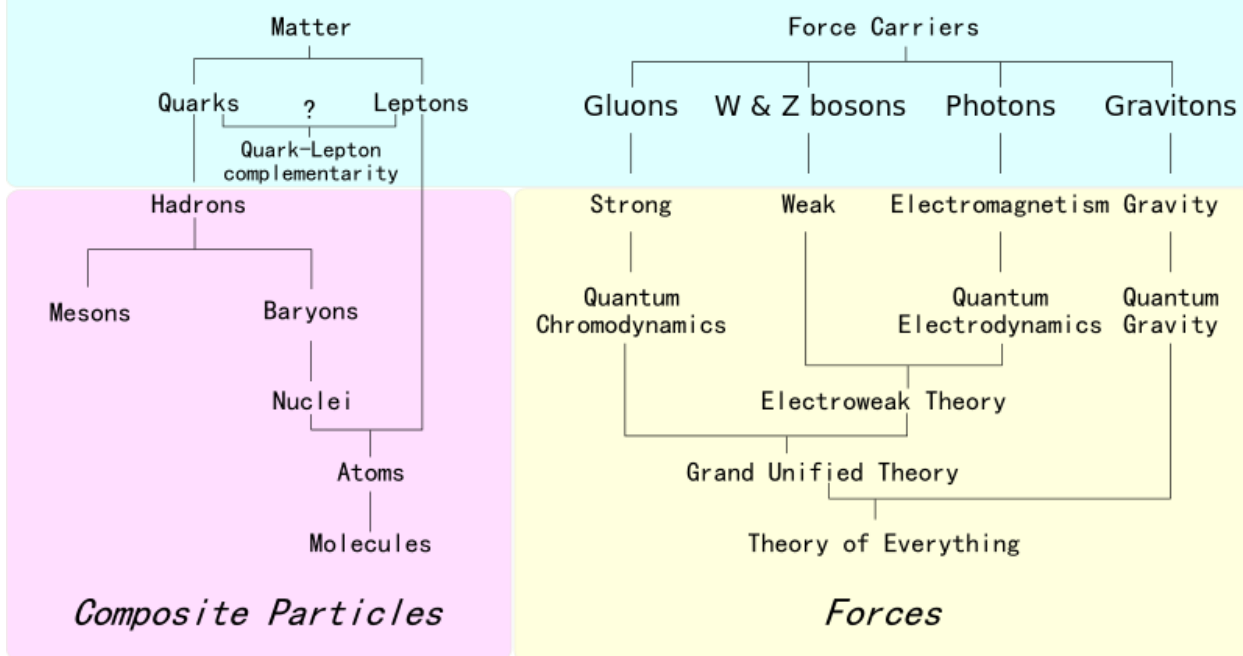


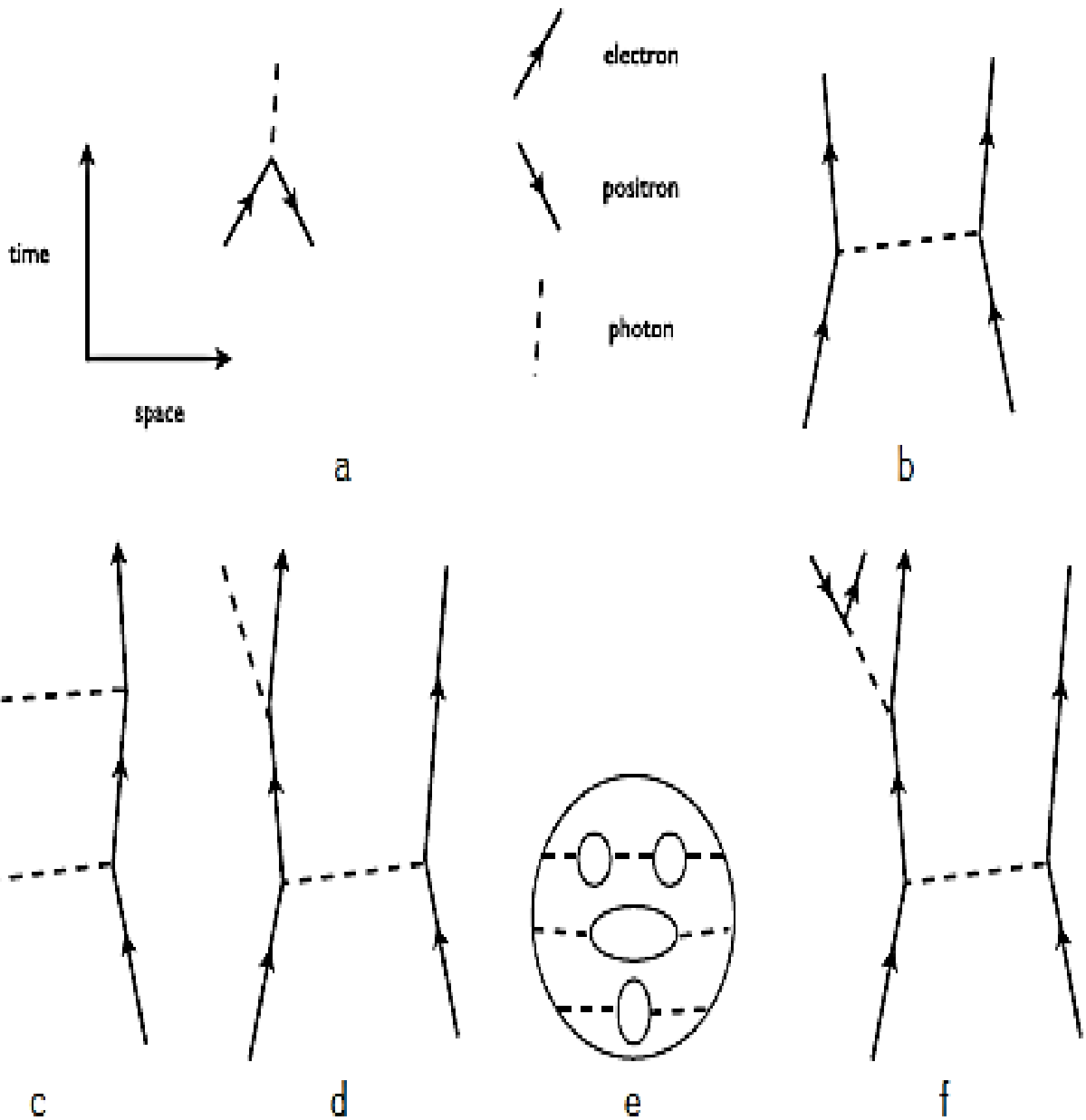
Giants at Work – Solvay above; Shelter Island below



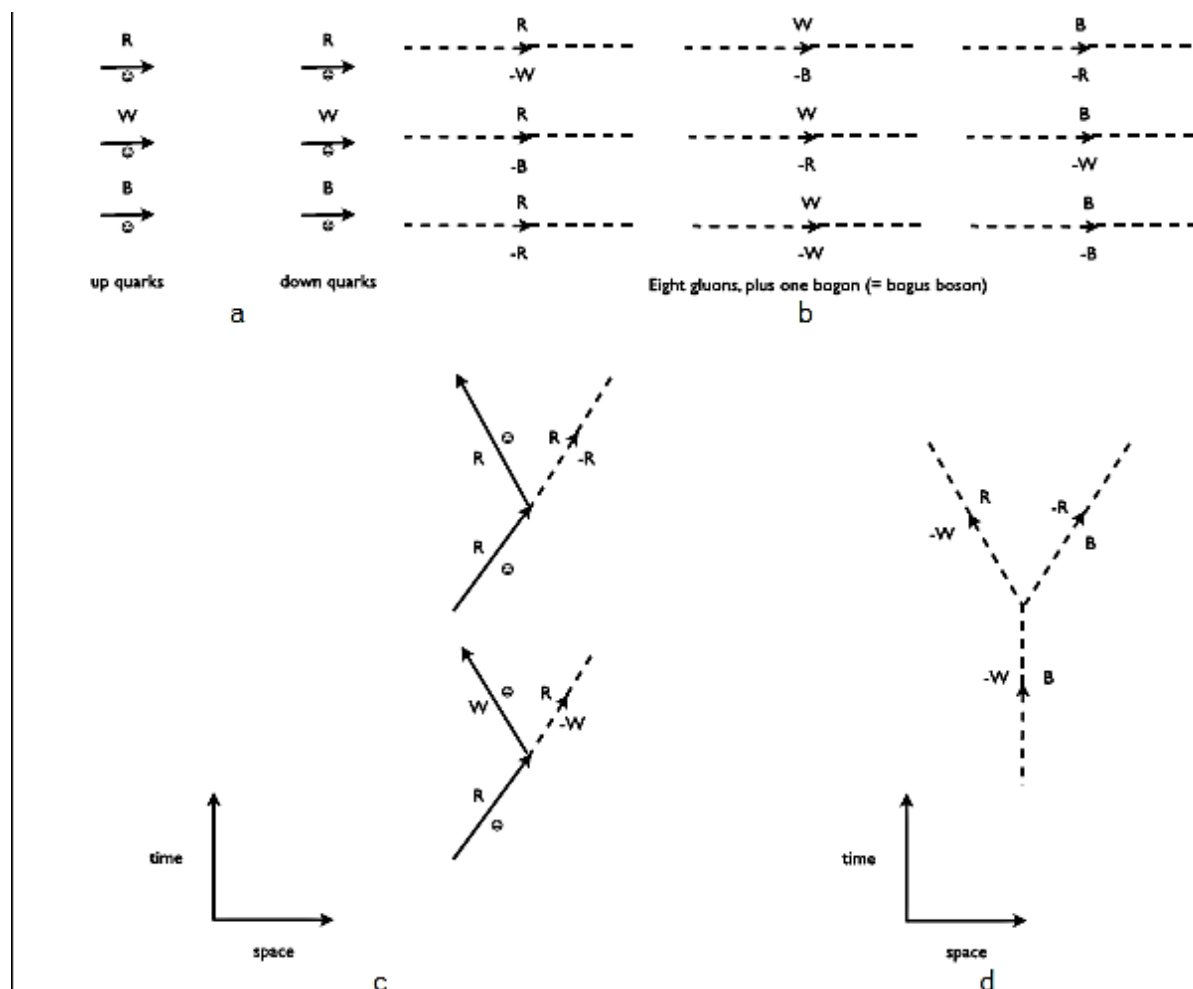
mass →	$\approx 2.3 \text{ MeV}/c^2$	$\approx 1.275 \text{ GeV}/c^2$	$\approx 173.07 \text{ GeV}/c^2$	0	$\approx 126 \text{ GeV}/c^2$
charge →	$2/3$	$2/3$	$2/3$	0	0
spin →	$1/2$	$1/2$	$1/2$	1	0
	u up	c charm	t top	g gluon	H Higgs boson
QUARKS	$\approx 4.8 \text{ MeV}/c^2$	$\approx 95 \text{ MeV}/c^2$	$\approx 4.18 \text{ GeV}/c^2$	0	
	$-1/3$	$-1/3$	$-1/3$	0	
	$1/2$	$1/2$	$1/2$	1	
	d down	s strange	b bottom	γ photon	
LEPTONS	$0.511 \text{ MeV}/c^2$	$105.7 \text{ MeV}/c^2$	$1.777 \text{ GeV}/c^2$	$91.2 \text{ GeV}/c^2$	
	-1	-1	-1	0	
	$1/2$	$1/2$	$1/2$	1	
	e electron	μ muon	τ tau	Z Z boson	
	$< 2.2 \text{ eV}/c^2$	$< 0.17 \text{ MeV}/c^2$	$< 15.5 \text{ MeV}/c^2$	$80.4 \text{ GeV}/c^2$	
	0	0	0	± 1	
	$1/2$	$1/2$	$1/2$	1	
	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	W W boson	
					GAUGE BOSONS

Elementary Particles





Wiczek - "The Lightness of Being." The essence of QED: photons respond to electric charge. b. A good approximation to the force between electrons, due to exchange of virtual photons. c. A better approximation includes contributions like this. d. Let there be light! An accelerated electron can emit a photon. e. A totally virtual process. f. Radiation of an electron-positron pair. The antielectron, or positron, is represented as an electron with the arrows reversed.



Wilczek – “The Lightness of Being.” The essence of QCD: a. Quarks (antiquarks) carry one positive (negative) unit of color charge. They play a role in QCD similar to that of electrons in QED. A complication is that there are several distinct kinds, or flavors, of quarks. The two that are important for normal matter are the lightest ones, called *u* and *d*. (To be honest, there are also different flavors of electrons, called muons and τ leptons, but I’ve been suppressing irrelevant complications.) b. There are 8 different color gluons. Each carries away a unit of color charge and brings in another color (possibly the same). The total of each color charge is conserved. There would seem to be $3 \times 3 = 9$ possibilities for gluons. But one particular combination, the so-called color singlet, which responds equally to all charges, is different from the others. We must remove it if we are to have a perfectly symmetric theory. Thus we predict that exactly 8 gluons exist. Fortunately, that conclusion is vindicated by experiment. Gluons play a role in QCD similar to that of photons in QED. c. Two representative core processes, where gluons simply respond to, or both respond to and transform, the color charge of quarks. d. A qualitatively new feature of QCD, compared to QED, is that there are processes whereby color gluons respond to one another. Photons do not.

1.2 - THE IDEA

“The initial mystery that attends any journey is: how did the traveler reach his starting point in the first place?” – Louise Bogan

“What’s the go o’ that?” – James Clerk Maxwell

I have an idea, of a world of Light, created from the Logic of emptiness. It may be crazy, but as Niels Bohr said: ***“What we need is a crazy idea. Does anyone have a crazy idea?”*** Here is the elevator pitch. The question is, to paraphrase Bohr again, “is it crazy enough?” It is always good to remember that QED, our best, most accurate theory of the world, is based on two crazy ideas: Dirac’s “Negative Energy sea” and Feynman’s “Travelling back in time”.

Proto-Light (PL), the basic “instance” of Existence, would come out of the void- A “Natural” binary choice between being and non-being. It would be a fleeting existence, clicking in and out of being, the balance being an undecided Chaos.

The PL creates its own “space” node. An accumulation of PLs, looked at in relation to each other, form an “emergent” **“Space”** mesh, which grows as more PLs emerge. Eventually, an accumulation of PLs at a node causes a PL Cluster formation, a PLC, a **Photon**... and ***then there was light***.

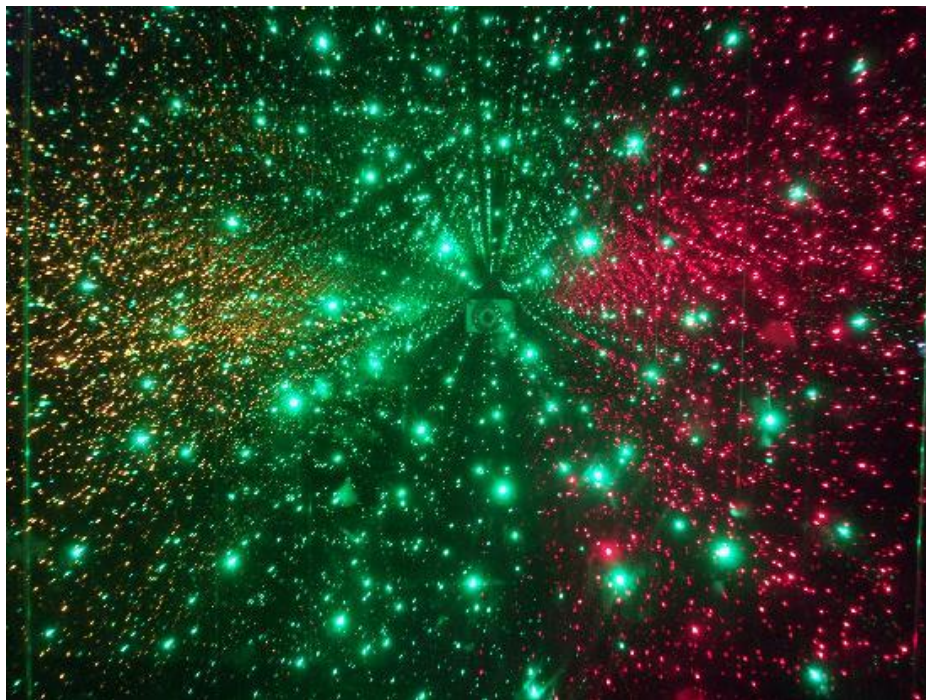
The Light cluster now moves between the nodes, its clicking rate defining time, another emergent feature tying the causality with the Light motion.

The **“Energy”** of light is a peak in the PL density then... A “Fourth” Dimension in the Space, a Warp in the Space. Unlike the current view, Energy does not warp space... Energy **IS** the **warp in space**, the accumulated PLs (nodes) focused – Vortices and Kinks in the emergent space Fabric. The Ripples of those warps are seen as the motion of Matter and Energy.

Those kinks and Vortices “travel” (as they try to unfold in their oscillations) at the speed of Light (so perceived by our senses) when in Photon clusters. In other formations, they would start other forms of resonances and loops, slowing down their forward motion, the ripples then becoming visible as **Matter**. Geometry Rules, and one Universal sheet of PLs ripples, waves and kinks along, creating everything we see (including ourselves).

Other Dimensions of this created “Space” (the logical Hilbert Space of Proto-Light creations) would present us with other features of the world- One dimension would provide the Electromagnetism we perceive; Others would present the Charges/ Colors of Quarks. Everything would be an emanation of Space, itself an emergent fabric from the PL World.

Once we have the basic building blocks above, we have the makings of our world, well explained by the Standard Model, Relativity, Quantum Mechanics and QED. Existence would spring from Logic, the ChaosKampf. Physics would come from the geometry. Matter and Motions would be correlations of the clusters of existence.



The Universe would be created from the Netherworld by Proto-Light, the Quintessence of Aristotle, the primordial element. Space would be a Fabric of Light, and all matter and energy bundles and kinks in that fabric. So we are not even “Bags of Mostly Water”, as the Trek Alien sneered; we are “Bags of Kinks in Space”.

But What a Space- A space made of Light, interconnected and woven intricately, its complexity self generated, the logic of the Void creating existence, the multitude of existence creating intelligence, all bathed in Light. From Nothing to Einstein; from Emptiness to Shakespeare; from Zero to Infinity - A truly Shining Universe.

2- BACKGROUND

“Do not keep saying to yourself, if you possibly can avoid it, ‘But how can it be like that’”... “Nobody knows how it can be like that.” - Richard Feynman

We will talk about Quantum Mechanics (QM), Quantum Electrodynamics (QED), and many fascinating inventions of the human mind to explain our world. As we do so, it will be important to keep an open mind.

A finite speed of light (c), and a discrete energy (h), bring us the wonders of relativity and Quantum Mechanics. If c was infinite, and h was zero, the world would make a lot more sense... (and probably won't work!).

QM and QED are the “most successful theories invented by man”. They have been verified experientially to a fantastic degree of accuracy. The Mathematics and the results are not in question.

What is in question is the interpretation of those theories. It is now well established that the Copenhagen interpretation of QM is not tenable as a coherent philosophical framework. It is a working approach that has given some very good results, but has failed to provide a satisfactory picture of the underlying reality. It avoided this issue by denying the existence of any underlying reality, pointing to the results as the only reality! Where it used to be said the proof is in the pudding, the Copenhagen crowd says the proof is only in the taste of the pudding, and, by the way, there is no pudding! Schroedinger called it “a philosophical extravaganza dictated by despair” – screaming: “I don't like it, and I am sorry I ever had anything to do with it”.

It is not that Quantum Mechanics is wrong – it is that the Copenhagen interpretation is unsatisfactory. The Bohrian rhetoric of old (“We see it cannot be otherwise”, “it is imperative to realize”, etc.) is a pre-play of String Theory's rhetoric (“The only game in town”). Even the easy going genius Feynman could not handle this crowd: “It became clear to me there was no communication between what I was trying to say and what they were thinking. Bohr thought that I didn't know the uncertainty principle, and was actually not doing QM right either. He didn't understand at all what I was saying. I got a terrible feeling of resignation.” At the same time, even Feynman submitted that “theoretical physics has given up” on “a model that explains how even the simplest phenomena actually work”, and that “there are no wheels and gears” beneath the analysis of Nature.

To paraphrase a school joke, QM works in practice, but what about in theory? Even Stapp, an avid proponent of the “Orthodox” Copenhagen interpretation, proclaims: “the impossibility of representing reality along accustomed lines does not automatically preclude every kind of conceptualization. Perhaps an uncustomary idea will work. Even Newton’s mechanical conception was not customary when he proposed it. Hence if advances in science reveal the incompatibility of empirical evidence with customary pictorial representations then perhaps the construction of a new vision of reality is needed, instead of meek resignation to the construction of practically useful rules. ... To operate most effectively in the physical world one needs an adequate conception of oneself operating within that world and upon it. Optimal functioning is impaired if you are armed only with Blind computational rules, severed from a rationally coherent conception of yourself applying those rules. ... neither the fear of failure nor the specter of non-uniqueness constitutes sufficient reason to refrain from at least trying to find some satisfactory understanding of our conscious selves imbedded in the reality that surrounds and sustains us.”

It is time to remove the smoke and mirrors, and part the “Great Veil” to take a closer look. Brian Greene is right – “There’s no denying that quantum dogma sounds a lot like snake oil”. The one time I disagree with Dirac: “The only object of theoretical physics is to calculate results that can be compared with experiment, and it is quite unnecessary that any satisfying description of the whole course of the phenomena should be given”. Miller and Wheeler imagined a quantum process as a “smoky dragon”. Born described it as an attitude: “What you mean by an objective world we don’t know and don’t care”. We care. Ignoramus (that we don’t know) may be acceptable and a limitation of our limited mortality; Ignorabimus (that we can’t know) is a bit too much to cede.

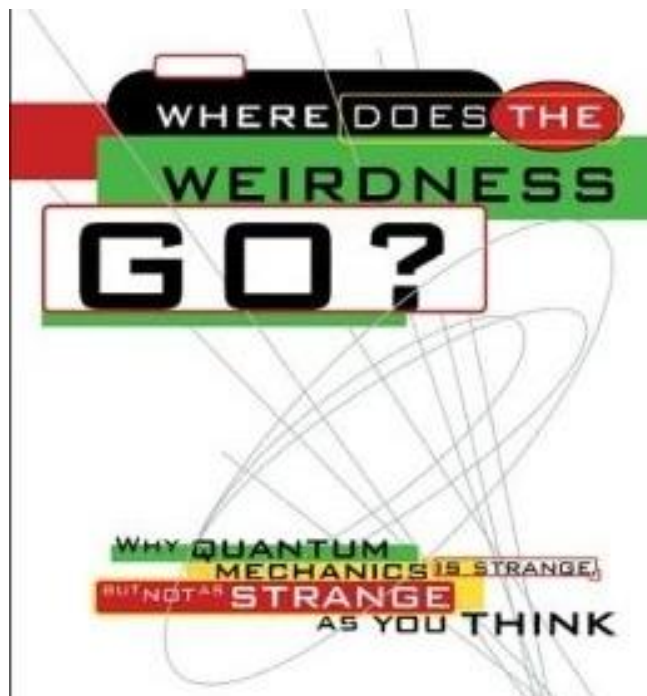
“One should not, even if a hundred trials fail, give up the hope of arriving at the goal – I do not say by means of classical pictures, but by logically consistent conceptions – of the real structure of the space-time process. It is extremely probable that this is possible.” – Schroedinger

“Some physicists, among them myself, cannot believe that we must abandon, actually and forever, the idea of direct representation of reality, in space and time; or that we must accept the view that events in nature are analogous to a game.”
- Einstein

“Whatever “Reality” may be, one has to explain how one perceives the world to be. QM does not do this and one must incorporate something additional into QM – something not contained in the Standard rules of QM”. - Roger Penrose



Great Veil Nebula



“... understand how great is the darkness in which we grope, and never forget that the natural-science assumptions with which we started are provisional and revisable things”. - William James

2.1 - OF SPACE AND TIME

"I am standing on the threshold about to enter a room. It is a complicated business. In the first place I must shove against an atmosphere pressing with a force of fourteen pounds on every square inch of my body. I must make sure of landing on a plank traveling at twenty miles a second round the Sun – a fraction of a second too early or too late, the plank would be miles away. I must do this whilst hanging from a round planet, heading outward into space."

- Sir Arthur Stanley Eddington

Try to think of space and time, and write a definition of them. You can't. Many have tried.

We think in terms of space and time, and define things in terms of space and time, so when we start to define space and time, we run into circular definitions that assume a definition to provide a definition. Jammer's essay on time describes thousands of attempts at simply defining "Simultaneity", what it means to be "at the same time". Scientist and Philosopher have pitched in, but the battle continues.

And when Einstein "proved" that space and time are inter-related, and "relative", you would have thought all hope is lost (he had to assume some things still not proven, because they can't be defined without "Conventions"- he also needed the help of his ex-teacher Minkowski, who always thought he was a lazy student ☺). Eddington famously when asked if it is true that only three people understood relativity, hesitated for a while, thinking who the third one could be, he said. But when you think about it, our language had always presaged this, as we "traveled through time", and "journeyed through life". An interesting property of space and time, their symmetry, basically says there is uniformity in all directions of space and time- nothing changes when you turn them around... another "Nothing" property that leads to everything (Conservation laws and the laws of physics).

So how fast are we going? Well, we "define" Fast by speed, aka velocity, aka distance traveled over time. Both of which are relative, and only definable by "convention" with major assumptions, like isotropy of "space", and simultaneity of events. If we woke up tomorrow with EVERYTHING expanded in size by a factor of 5, could we tell the difference? How would we know? The ruler we use to measure distance, the wavelength of light, everything would

have expanded. We would never know. Since space is relative, “nothing has happened at all, which is why we have perceived nothing” (Poincare’).

And what time is it? Try to look at the world “now”. What you see is not Now. You can never see Now. Look out your window- what you see is your immediate neighborhood in the near-now (in the fraction of microseconds it takes light to reach you), the Sun 8 minutes ago, the stars years and millions of years ago, **where** they were THEN, and **how** they looked THEN. What we see is a slice of spacetime that bends back in time as we peek farther out – all the way to the singularity. Now is never here for us – it is a relative concept. As Lawrence Krauss amusingly puts it – if you took a class picture of your high school team with the back seats millions of miles away, the resulting picture would show the way the people in the front seats looked while the people showing in the back seats had left for lunch already. Time may be God’s way to prevent everything from happening at once, and our modern hectic lifestyles may be challenging God’s will in this respect, but we still don’t know what it is.

And how heavy are we: We define mass as the resistance a body provides to change in velocity (its “inertia”, or inertial mass). So is Mass an intrinsic property of a body, or is it just the Kinematics & Dynamics that make it look like it has mass? The “Obvious” answer you have carried in your mind turns out to be not the right one. Mach, among others, thought Force and Mass as purely mathematical expressions relating certain measurements of space and time. Newton’s second law, $F=ma$, is just a definition of force, an empty tautology. It could also be a definition of mass. They relate to acceleration effects, $\text{space}/\text{time}^2$. The equation doesn’t tell you what F or m are, useful as it has been in practice. Max Jammer: “One has to admit that in spite of the concerted efforts of physicists and philosophers, mathematicians and logicians, no final clarification of the concept of mass has been reached.” (Concepts of Mass in Classical and Modern Physics). The “Maza” of the Greeks is inferior bread indeed.

Modern Physics says that most particles have no intrinsic mass. On their own that is. But a funny little particle, named after Higgs (a co-discoverer with Brout, Englert, Guralnik, Hagen and Kibble, who somehow captured the full glory), living in a Higgs field that permeates the Universe, acts like molasses to some particles, giving them “drag” when they try to move, and makes them look like they have mass. More on this later.

Charge, by the way, is equally mysterious. Electrical charge is so ubiquitous we take it for granted that we understand it. But what is the charge itself? What does the electron “have” that gives it a charge? And what does the positron “have” that gives it an opposite charge, or a “shortage” of the charge the electron has? And why does it come in exact increments? And how could it be, if Dirac is right, that the presence of one single magnetic Monopole anywhere in the universe would guarantee that charge is quantized the way it is?

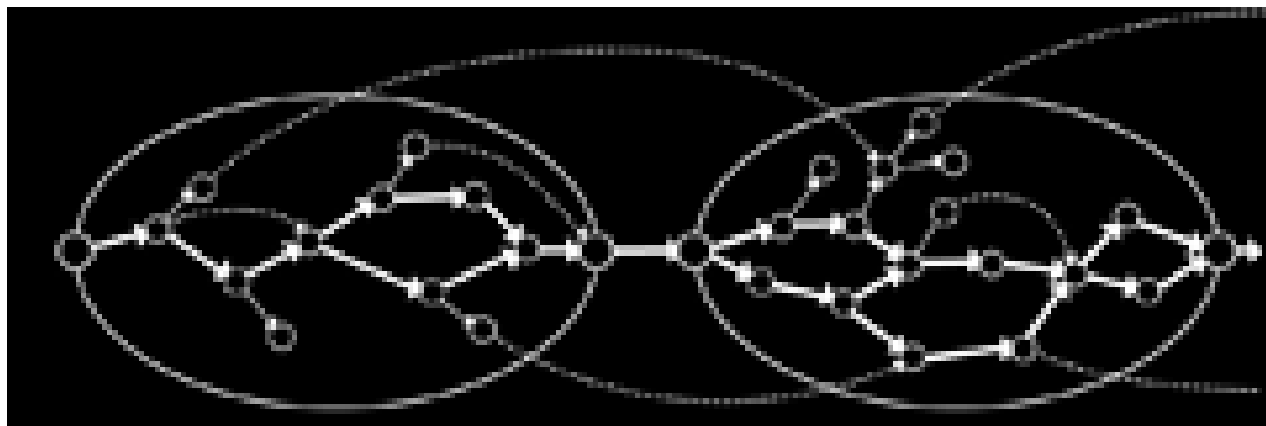
And what of those “flavors” and “colors” of charge that abound in quarks and other subparticles? Are they more of the same, just different, or a whole new game? Is all of this just crinkles in the geometry of space that we “feel” in certain ways that we then label as “charge”, “color”, etc.

Geometry of space seems to be a critical clue. Kaluza & Klein postulated an additional hidden dimension of space, which very neatly explained Electromagnetism and charge jointly with Gravitation, something modern String theory with its 10/11 dimensions still tries to expound. (A simplistic view of Kaluza-Klein: uncharged particles move only in a 3+1 subspace, but charged particles move in 4+1 dimensions, their direction of motion determining their charge.) The Symmetries of space and time lead directly to Noether and the conservation of energy (time symmetry), momentum (space translation) and angular momentum (rotation symmetry), while similar symmetries underlie our modern field and gauge principles. The magical number 3 gives us our 3 visible space dimensions, which seem the only stable configuration, while similar dimensionality restrictions relate to charges, defined with “imaginary” components in their Quaternion quartets and “Spinor” appearances. The Shadows of those hidden dimensions may hold the key to the mysteries of unification.

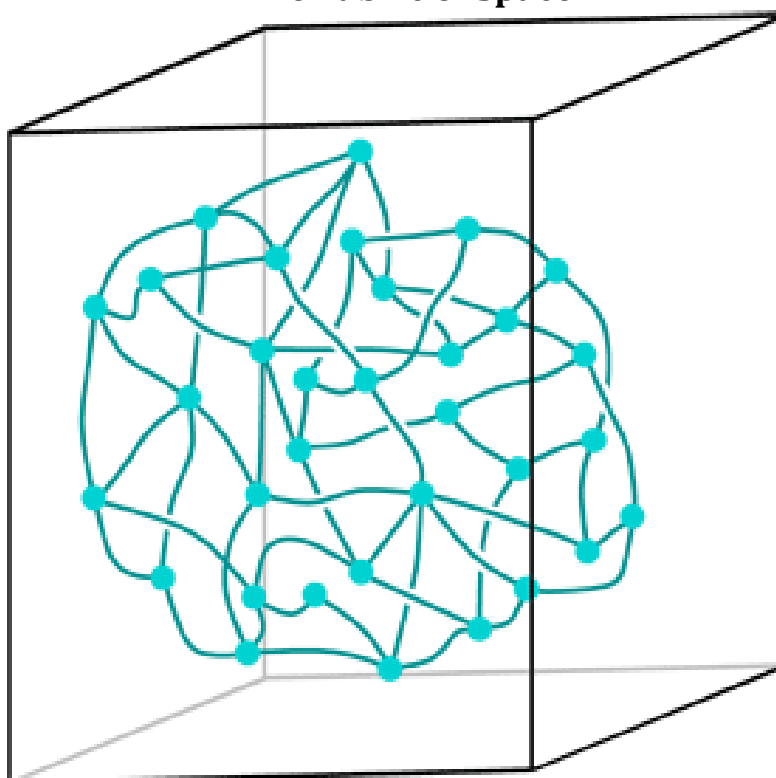
Before leaving this, I must mention the lovable dissenting view of Mr Aspden, who has a completely thorough view of a “classical” picture, Ether and all, that repudiates Einstein, relativity, and a lot of the new science. Worth a read, especially if you are interested as to how he has calculated some basic constants from scratch... the triangle between Luck, Loony and genius is ever so vague.

“While it is true that the more one thinks about relativity, the more understandable it becomes (at some point one gets the feeling that relativity is actually a logical necessity!), one can hardly say the same thing about quantum mechanics.” – Laloe

“Quid est ergo tempus? Si nemo ex me quaerat, scio; si quaerenti explicare velim, nescio’. What then is time? If no one asks me, I know, if I want to explain it to someone who asks, I do not know”. – St. Augustine



The Fabric of Space



“Probably most particle and quantum theorists now would consider accurate visualizabilty (and possibly even mathematical consistency) to be a luxury or even a forlorn hope; they are happy if their theories can yield calculable and testable predictions, and even that is no longer a given in modern particle theory.” - Peacock

2.2 - QUANTUM ENIGMA

***“Einstein said that if quantum mechanics were correct then the world would be crazy.
Einstein was right- the world is crazy.” – Daniel Greenberger***

The Quantum mystery argues more than the usual incremental progress that science has usually faced. Its discovery was “almost frightening” (Heisenberg).

It challenges at the root of its assumptions the questions of existence of a reality of things, and the causal Locality of existence. Feats of genius by John Bell and Leggett have given evidence that Locality is not feasible, and reality is ephemeral.

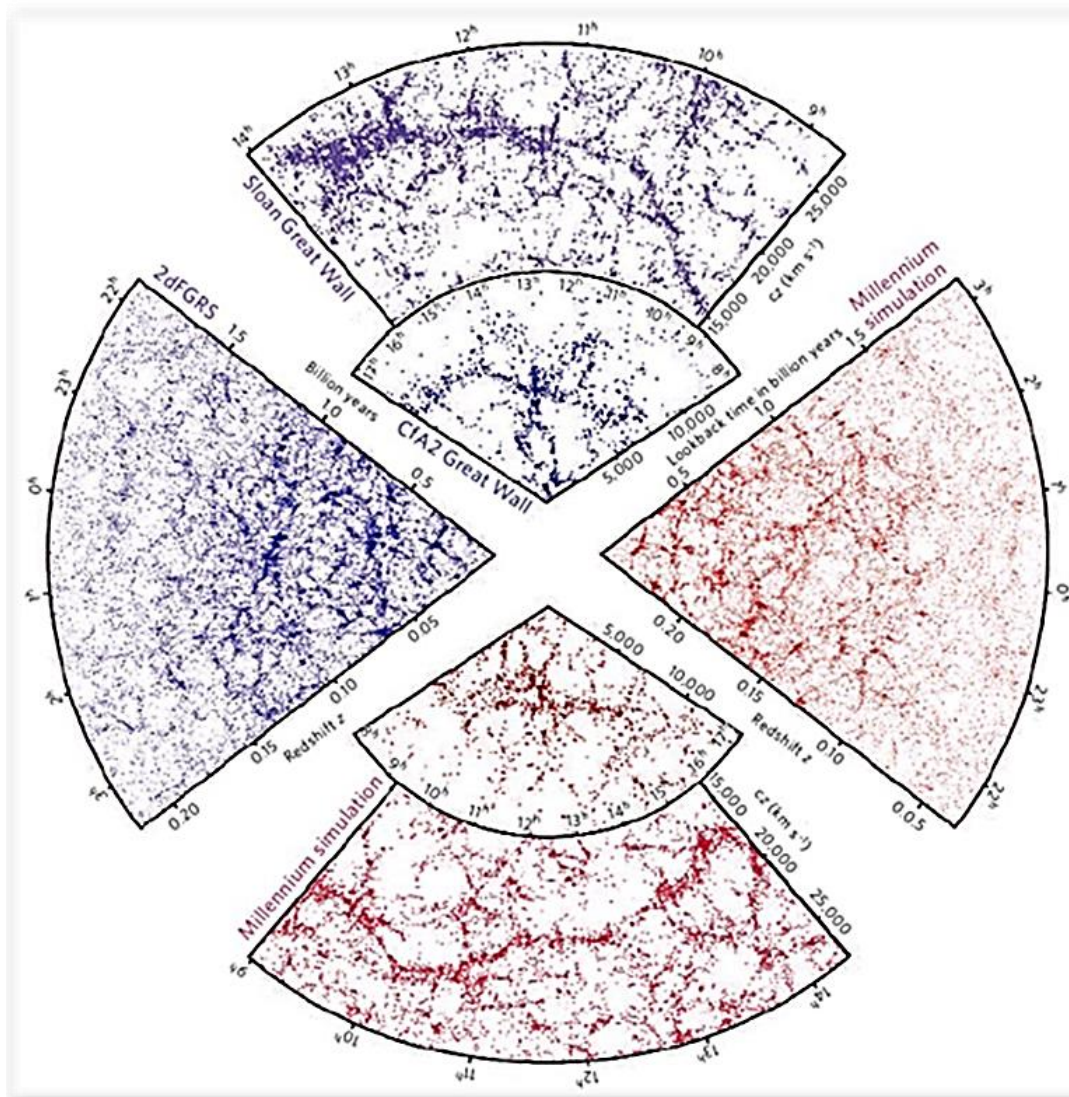
But the math works! And life seems to imitate our Art!!

The Eerie success of the scientific endeavor has led some to believe that our consciousness may be generating the world as we go along- that we find what we seek if we seek it well enough in our collective mind. Experiments where things have been seen and then never seen again, normally dismissed as anomalies, start looking like temporary creations (as opposed to hallucinations) of the imagination. More soberly, Einstein would say, when asked what he would have thought if his relativity predictions had failed Eddington’s expedition test: “Then I would have been sorry for the dear Lord, for the theory is correct.”



David Bohm

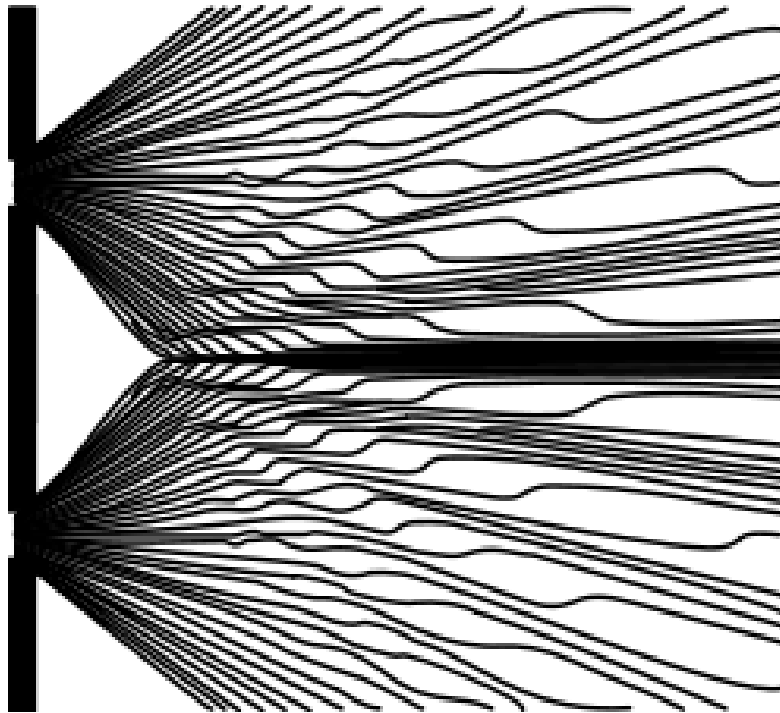
Duc de Broglie



Simulation versus RedShift Measurements!

What does it mean for the world to be non-local, not “real” and indeterministic? It means you can throw everything you thought you knew out the window. Richard Feynman, that great, funny Nobel Laureate of QED fame, said that nobody understands Quantum Mechanics. And yet here we are, seemingly real, and our world “apparently” local and causal. We can kick a stone, and the resulting pain would be our proof, as Samuel Johnson suggested. The amorous Erwin Schroedinger (whose “muses” usually did not include his wife ☺) almost gave up on Quantum theory (whose main equation he provided during a romantic interlude), scared of that “jumping” it entailed, and worried about his Dead and Alive cat that it would lead to. Bohm and De

Broglie resorted to “Ghost” fields to try to salvage what they could of their beloved reality.



The Bohmian trajectories for an electron going through the two-slit experiment. A similar pattern was also extrapolated from weak measurements of single photons

Is Quantum theory complete? The question dogged Einstein and the Knaben-Physics club of Quantum theorists, and the legendary Einstein- Bohr debates never resolved the issue. The incomplete answers spurred visions of “Many-Worlds” a-la Everett and Deutsch, inaugurated Quantum logic, and explored the “Landscape” theories and Multi-Verse concepts. The concept of the Universe as a computer (a program run on an abstract computer rather than a real one), with information as the basis of reality, mapped onto a “Holographic” image we see as reality, finds acceptance by many, strengthened by strange findings on the Entropy of Black-Holes and information contents proportional to surface area and not volume of space. My daughter reminds me of Hawkings’s quip: “Einstein was wrong when he said “God does not play Dice.” Consideration of Black Holes suggests, not only that God does play Dice, but that “he sometimes confuses us by throwing them where they cannot be seen.””

The EPR experiments, John Bell’s inequalities, and the mystery of how two particles/photons billions of miles away seem to “communicate” or influence

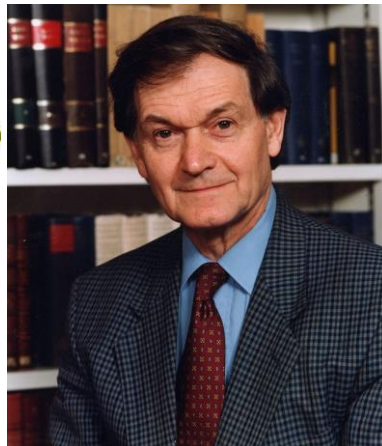
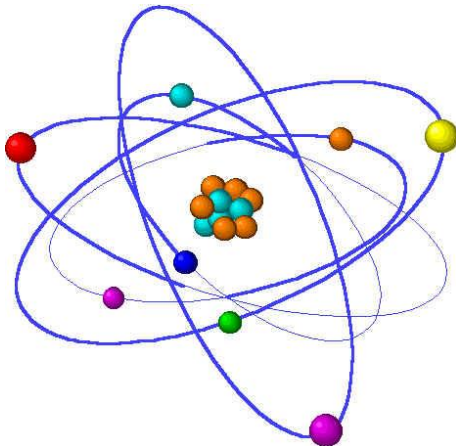
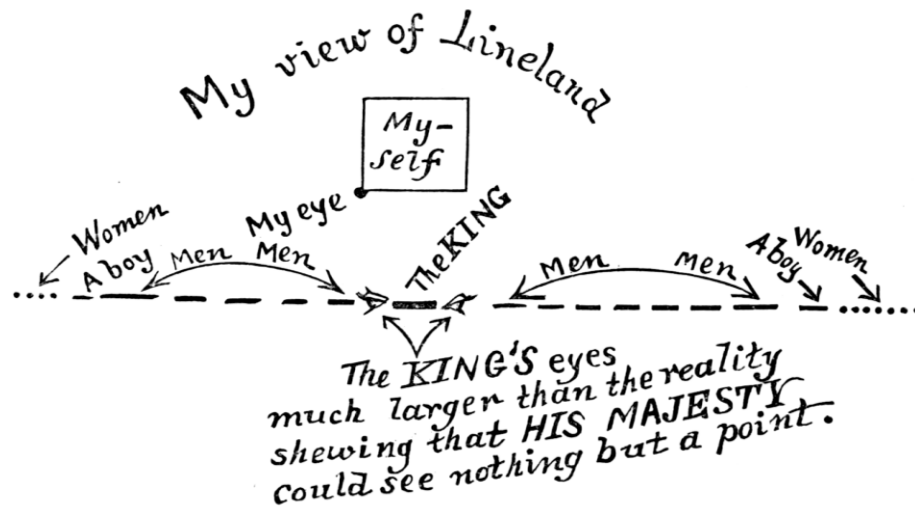
each other instantaneously (and hence not Lorentz invariant – Bell) are still unresolved. Interference experiments that show photons and electrons somehow “knowing” you are measuring their path, no matter how subtle or N’t order the method of detection is, and changing their behavior accordingly, confound the mind. Particles and Photons that take “All paths” to a target, but can change their mind mid-stream if they suspect you changed the setup or detected their path, almost lead you to believe they have all-knowing minds of their own. Explanations like Dieter Zeh’s decoherence, Penrose’s gravity effects, etc... fall short of explaining this bizarre behavior. You are almost led to believe in an external influence, something outside space and time directing these affairs, with access we don’t have, and speed we can’t imagine. E.H. Walker thought photons may be “conscious”.



Picht, analyzing the relation between Ontology and Logic, wisely concluded that the laws of logic we know reflect the structure of being, as many philosophers had obtained. It seems the epistemological crisis we have with quantum phenomena is a result of having discovered a domain (the microworld) whose ontological structure is no longer amenable to the application of conventional logic we grew up on in our macro-world. The square pegs of the quantum will not fit into the roundholes of spacetime, as one of my favorite bloggers says.

The CRT Analogy of our world as a mapping of an image elsewhere on a three dimensional surface begs its own explanation, but could explain many of the mysterious shenanigans of the Quantum micro-world. Much as a fictional

character on a TV screen would have trouble explaining how things move in his world, we may be characters (fictional or real) in a three dimensional world, projected from a different plane (dimension?), where we might see a different aspect, a-la “Flatland” scenario.



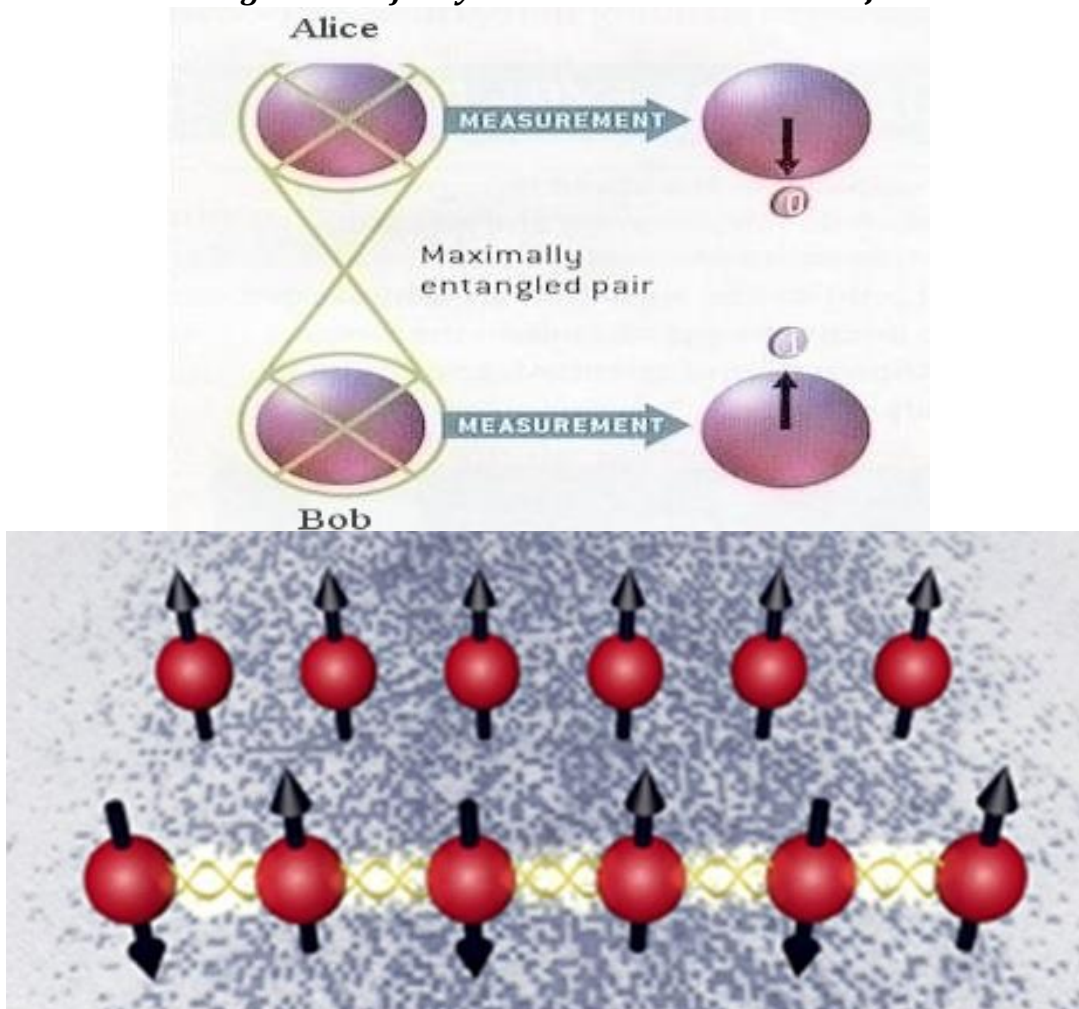
Roger Penrose

“Every Ansatz (theory) which claims universal validity is threatened by the sphinx of modern physics, quantum theory.” – Kaluza

“One really ought to be ashamed of its [QM’s] success, because it has been obtained in accordance with the Jesuit Maxim: “Let not thy left hand know what thy right hand doeth”” – Einstein

“In your theory you must identify some things as being really there, as distinct from the mathematical concepts that you can easily devise – like the projection of the side of a triangle to infinity and so on. We must decide that some things are really there and that you are going to take them seriously. These are the beables. ... Another good word

is kinematics. ... I would want the kinematics of your theory [to] tell me what it is you are talking about before you tell me what about it.” – John Bell



*“At Bohr’s feet I lay me down,
For I have no theories of my own.
His principles perplex my mind,
But he is so very kind.*

Correspondance is my cry; I don’t know why; I don’t know why.”

Christmas carol of Manchester University students of Leon Rosenfeld, Bohr’s protégé.

“I am a quantum engineer, but on Sundays I have principles.” – John Bell

“With law going and chaos arriving, one principle remains, the quantum principle.

With all other laws of physics rated as mutable, it is the only principle. If no one ignorant of evolution has the first idea about the origin of life, it is also true that no one who is unacquainted with the quantum principle has the first idea how nature works.

Physics without the quantum is medieval physics.” - Wheeler

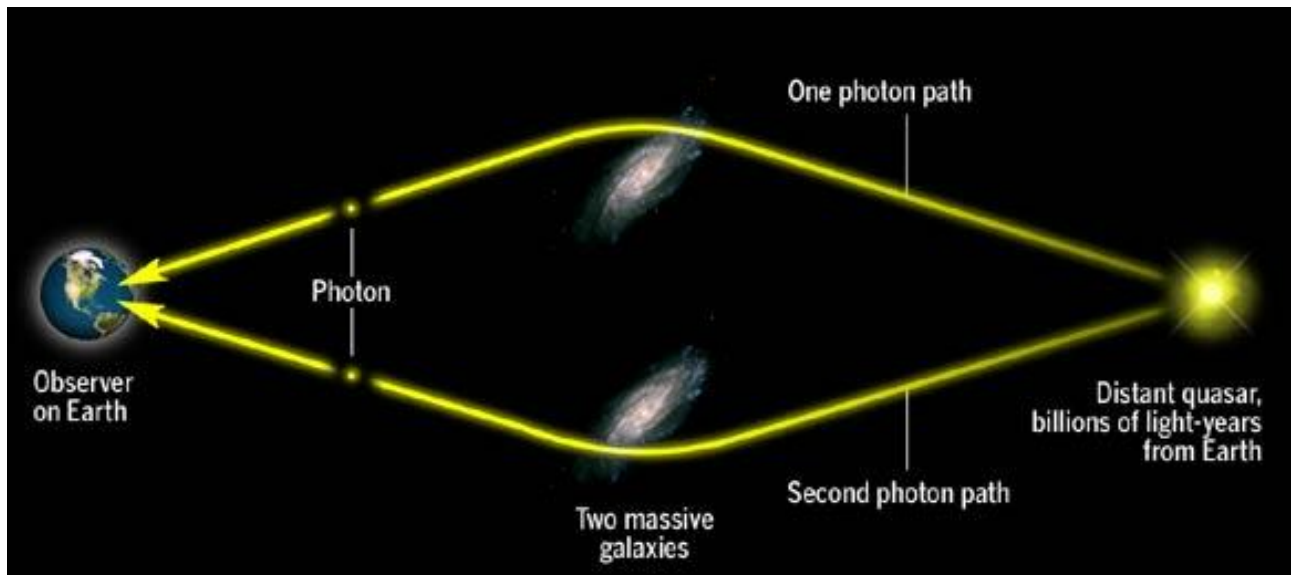
2.3 - ENTANGLEMENT - THE ONLY "MYSTERY"?

"My own suspicion is that the universe is not only queerer than we suppose, but queerer than we can suppose." – J.B.S. Haldane

"Where there's Smoke, there's Smoke" - John Wheeler

A photon is timeless. If you take relativity seriously, a photon traveling at the speed of light (itself ☺) does not 'feel' time pass. All of eternity is an instance for it. While the twins paradox may be surprising, where time slows down for a traveling twin, a twin being made of light would slow time down infinitely, and live eternity in an instant. A being of light (an Angel?) would be truly eternal.

Meanwhile, an anti-particle behaves like a particle traveling backwards in time. Wheeler took that literally. Perhaps he was right. Feynman thought so as well. Later, Wheeler would look at delayed-choice experiments, where the experiment "reaches back into the past in apparent opposition to the normal order of time", even on cosmological scales. A choice by an experimenter now could change history - what "shall have happened in the past." (Relax... Bohm can handle this too ☺).



And did you know that we all travel at the speed of light? If you consider time as the 4th dimension, we all move at 300,000 km/sec. If we are stationary in space, we move in time at regular speed equivalent to that speed. If we move in space, we slow down in time enough to keep at that speed (movement in

time and space being vector additive). So really, Time does not fly when you are having fun... it actually slows down.

And Matter and Energy are equivalent. One minute matter looks like a wave (energy), a minute later a wave looks like matter. There's even a formula for it... the most famous formula in Physics, the only physics formula that fits on a T-shirt, and the only one the average man of the street recognizes: **$E=mc^2$** .

QM is saying there is no "here" or "there", but a "here and there" - an electron is all around the atom, and a photon can go through "both holes" in a slit experiment, instead of choosing one.

Now comes the rub:

Entanglement, that quantum mystery of mysteries, with its correlate non-locality, where particles light-years away behave as if they know what the other is thinking, is trying to tell us something. If Distance makes no difference for an entangled particle, and Time makes no difference for a photon, and if we are made of particles/ photons/ same thing, then distance and time should make no difference to us. The Time and distance we hassle with daily are not what we think they are. Alice's adventures in Wonderland are fact, not fiction, seen in a haze of uncertainty.

Entanglement may not violate the letter of General Relativity (since messages still can't be sent faster than the speed of light), but it certainly violates the spirit of that law. "Something" still travels faster than light (actually, infinitely fast, instantaneously) between entangled particles. All of this comes out naturally from the equations of Quantum Mechanics, which we use but don't fully understand. To paraphrase Dirac, "Our equations are smarter than we are."

"The conclusions from Bell's theorem are philosophically startling; either one must totally abandon the realistic philosophy of most working scientists or dramatically revise our concept of space-time." - Abner Shimony and John Clauser

Maybe light (energy?) is the "single framework" (Teilhard de Chardin), the singular dimension, casting a shadow in 4 directions, 3 of which we call space, and one time. It is eternal in the sense of always being in the same moment- so it has no "time" as such. It just moves its shadow in the 4 dimensions, sometimes showing up as matter, slower than light, sometimes as light. The Duality of waves and matter becomes a mystery no more. Entanglement

becomes a natural, since the many come from the one, and distance/time become ephemeral. All of a sudden, many a philosophers' argument – This world being a reflection of a more perfect higher world, Unity in the One, and its various manifestations start to make sense (albeit for other reasons than they had intended).

Maybe we are beings of light, reflected in shadows of space and time, while our essence is timeless and covers all space, Entangled with everything else it has ever touched (and hence entangled with everything), part of one multi-faceted unity. Philosophers and spiritualists could feast on that, until we could understand the science and make it another run-of-the mill theory. Finally Einstein would be vindicated... once we explain the mystery of Entanglement, his EPR paradox, and give him the scientific physical basis of Quantum theory, instead of Bohr's arm-waving complementarity.

Let us play with this some more, this time using some Gedankenexperiments, "thought experiments", Einstein's favorite Style:

Say you are a photon, running around at the speed limit. Looking around, it may look to you like you were standing still and the world is speeding by at the speed limit. And relativity says, an object going fast relative to you suffers a "contraction" in size. Someone running at the speed limit would actually contract all the way to Zero. So what would you see, as the photon? You would see the world shrink to nothing.. The world becomes a point... All the Universe and all the stars would come together in one little singularity... everything would be right there... you don't have to go anywhere to get to it, at any speed. It would all be touching, in contact, Entangled from your point of view. The two photons of Einstein's EPR paradox would be at the same spot, not at any distance. They need no special way of communicating and there would be no mystery... just reach out and touch someone, as they say. If you are a photon, the world is your oyster.

But wait... didn't we say matter and energy are equivalent? Isn't everything a form of energy? Isn't everything made up of photons then? Then doesn't everything see the world as a singularity? Doesn't everything then touch everything then? Isn't everything totally connected to everything else?

The mystery then is not the entanglement, but how the shadows and projections seem to "US" so real and spread out. If we can figure out how this

Unity displays its colors on the larger canvas we see, how it translates into the uniform laws we “observe”, how this (Holographic?) reality emerges, then we can better understand our place in this game. Page and Wootters see quantum entanglement explaining time emergent, clicking for us internal observers while looking static (a-la-Wheeler-Dewitt) to an external observer (God?). Sorli et. al. see a 4D space, with time a numerical order of material change and photon motion in that space, with relativity only starting at the level of massive particles, while the planck size quanta of space interact instantly .

Once we have a hold on this, other mysteries almost melt away. If we are forms of energy, then shouldn't the basic building block be the photon? The Standard Model has tens of “basic” building blocks, electrons, quarks, muons, etc. But when an electron meets a positron, they instantly turn to “energy”, aka radiation. How far of a stretch is it then to say they were already made of radiation/ photons. That they were a special configuration of photons, packaged in a stable set-up, that gives them their “apparent” properties. Maybe their charges are part of their geometric properties. We already say the forces between them (Electromagnetic forces) are exchanges of photons- so we know their bag hold photons to exchange, but also maybe their whole being is those photons.

Maybe all the forces we know, the Electromagnetic, weak, strong and (yes) Gravitational forces are all ways those “bags of photons” interact. In their Entanglement, they form the basis of our Physical Reality, jewels in Indra's Net, the interdependence of all things, as the Mahayana Buddhist thought.

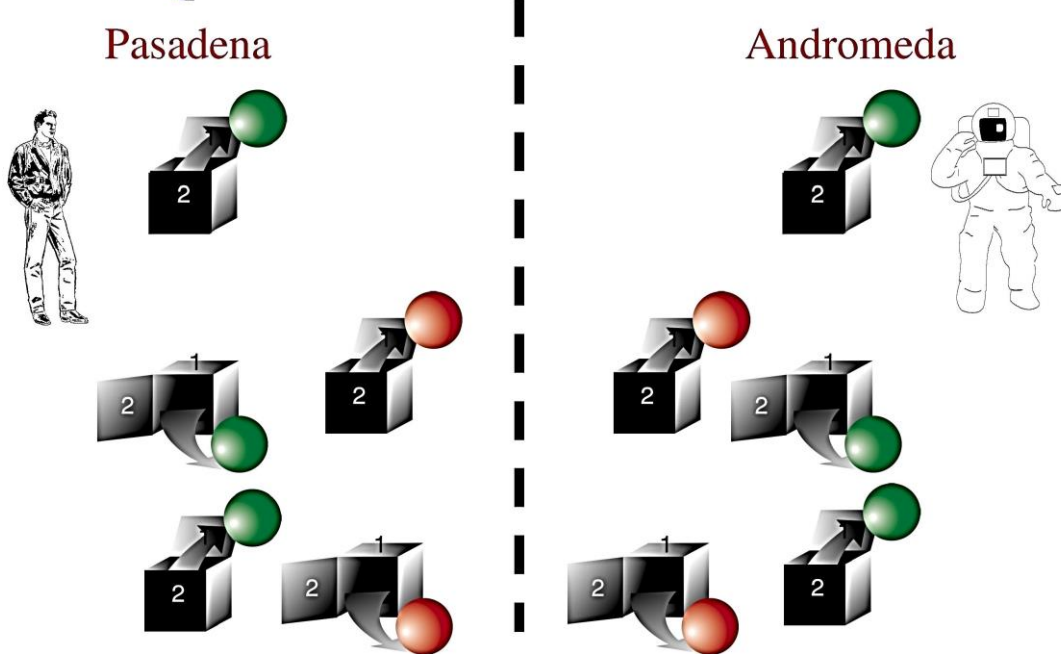
“We choose to examine a phenomenon (the double slit experiment) that is impossible, absolutely impossible, to explain in any classical way, and which has in it the heart of quantum mechanics. In reality, it contains the only mystery.” – Richard Feynman

***“All things ... Linked are,
That thou canst not stir a flower
without troubling a star!!”***

- Kepler

“The opposite of a truth is also a truth! Scientists say that matter is not possible without mind! All possible worlds are actual worlds! Wow! And the journalists can write these things with good consciences, for things like this have indeed been said ... out of working hours ... by great physicists.” – John Bell ☺

Quantum Correlations

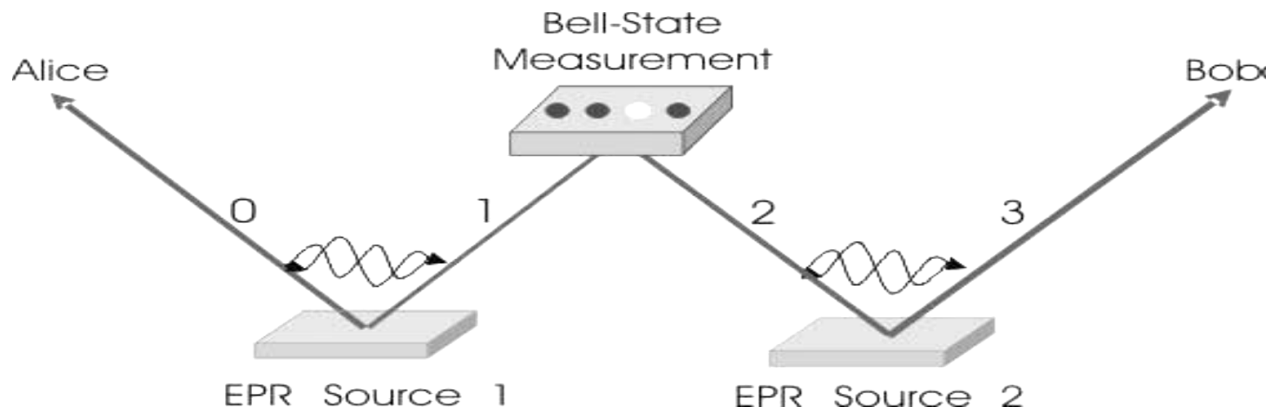


But if we both open the same door, we always find the same color.

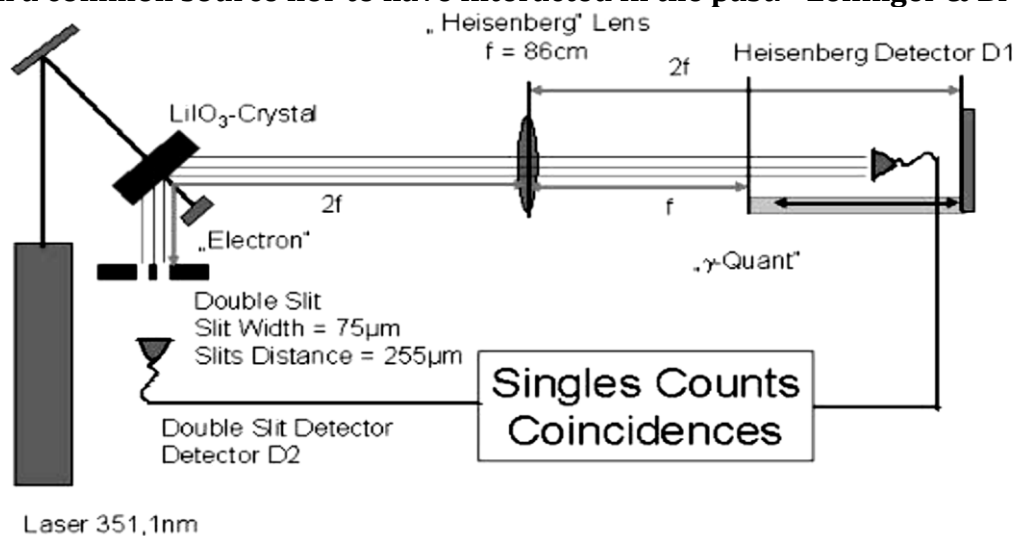
“... in the course of time one may find that because of technical pragmatic progress the ‘Problem of Interpretation of Quantum Mechanics’ has been encircled. And the solution, invisible from the front, may be seen from the back.” – John Bell

“I think that conventional formulations of quantum theory, and of quantum field theory in particular, are unprofessionally vague and ambiguous. Professional theoretical physicists ought to be able to do better. Bohm has shown us a way.” – John Bell

“There is a (no doubt apocryphal) story about a person who always spread salt on the floor before going to bed at night. The reason for doing so was ‘to keep away the tigers’. When told that no one had ever seen a tiger in this part of the world the reply was ‘that shows how cleverly they keep out of sight and what a good job the salt is doing’. An important test of any scientific theory is that it should have no ‘tigers’ – i.e. no unnecessary postulates. The difficulty with theories of quantum measurement is that they all appear to contain ‘tigers’ of one kind or another and there is no general agreement about which theory contains the greatest number or the fiercest ones!” – Rae



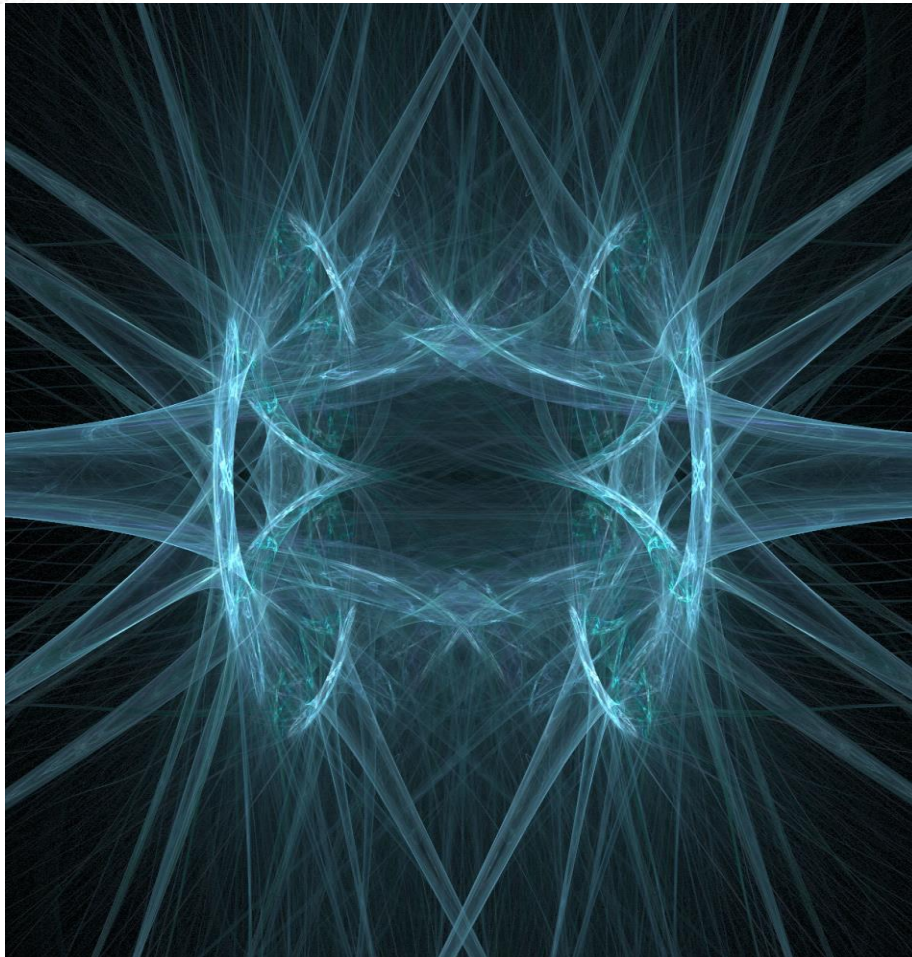
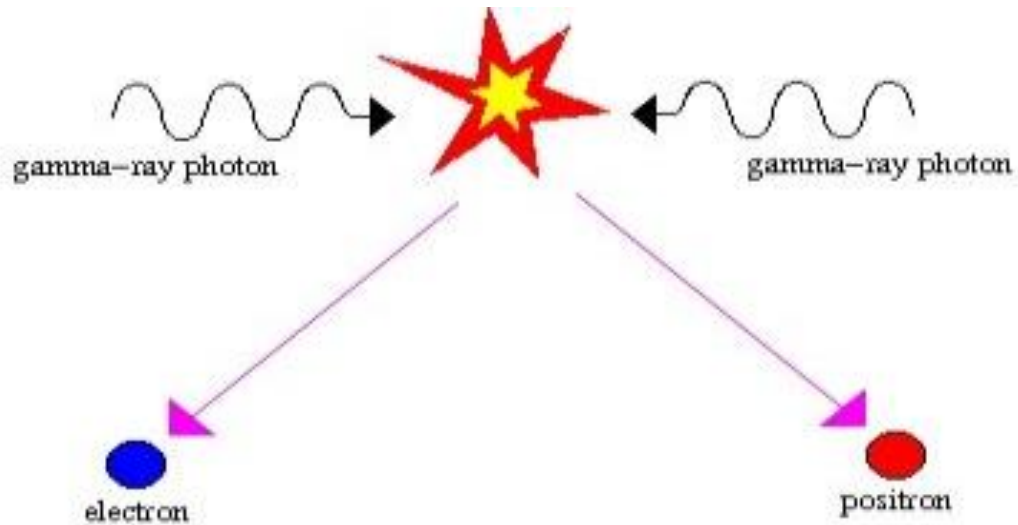
Scheme for entanglement swapping, i.e., the teleportation of entanglement. Two pairs of entangled qubits 0-1 and 2-3 are produced by two Einstein-Podolsky-Rosen (EPR) sources. One qubit from each of the pairs is sent to two separated observers, say qubit 0 is sent to Alice and qubit 3 to Bob. The other qubits 1 and 2 from each pair become entangled through a Bell-state measurement, whereby qubits 0 and 3 also become entangled. This requires the entangled qubits 0 and 3 neither to come from a common source nor to have interacted in the past. - Zeilinger & Brukner



Double slit experiment for a photon of an entangled pair [6, 7]. A pair of momentum-entangled photons is produced in the crystal by type-I parametric down-conversion. One of the photons enters the Heisenberg microscope and is detected by the Heisenberg detector placed behind the Heisenberg lens. (It plays the role of the γ -quantum in the standard Heisenberg microscope experiment.) The other photon enters the double slit assembly and is detected by the double slit detector. (It plays the role of the electron.) If the Heisenberg detector is placed in the imaging plane of the lens, it can reveal the path the other photon takes through the slit assembly, which therefore cannot show interference. Alternatively, if the Heisenberg detector is placed in the focal plane of the lens, it projects the state of the other photon into a momentum eigenstate which cannot reveal any information about the slit the photon passes through. This photon therefore exhibits an interference pattern in coincidence with the registration of the other photon in the focal plane of the Heisenberg lens. - Zeilinger & Brukner

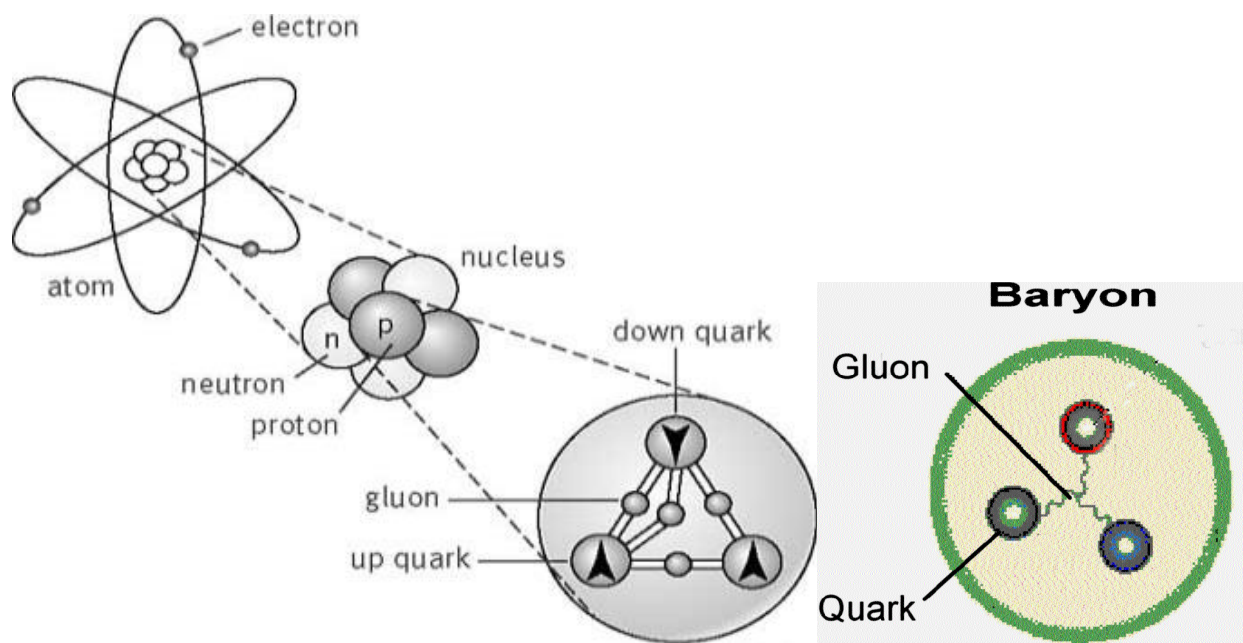
3 - FOUNDATIONS

If Matter and antimatter annihilate into light, then maybe light is their core component? Brilliant insight! You wouldn't think twice about the content of two bottles, if wine splashed out when they smashed together.

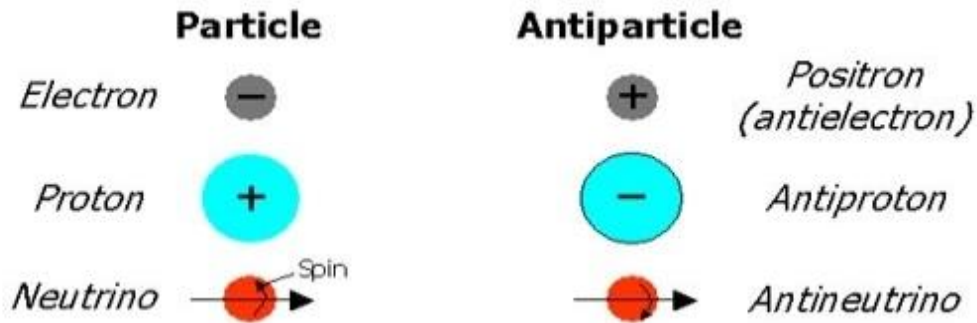


“The particles are ... seen as dynamic patterns, or processes, which involve a certain amount of energy appearing to us as their mass. In a collision process, the energy of the two colliding particles is redistributed to form a new pattern, and if it has been increased by a sufficient amount of kinetic energy, this new pattern may involve additional particles” (Capra).

If Atoms are made of Electrons and Nucleons, and those are made of Quarks, and Quarks could be made of Preons, maybe Preons could be made of Proto-Light.

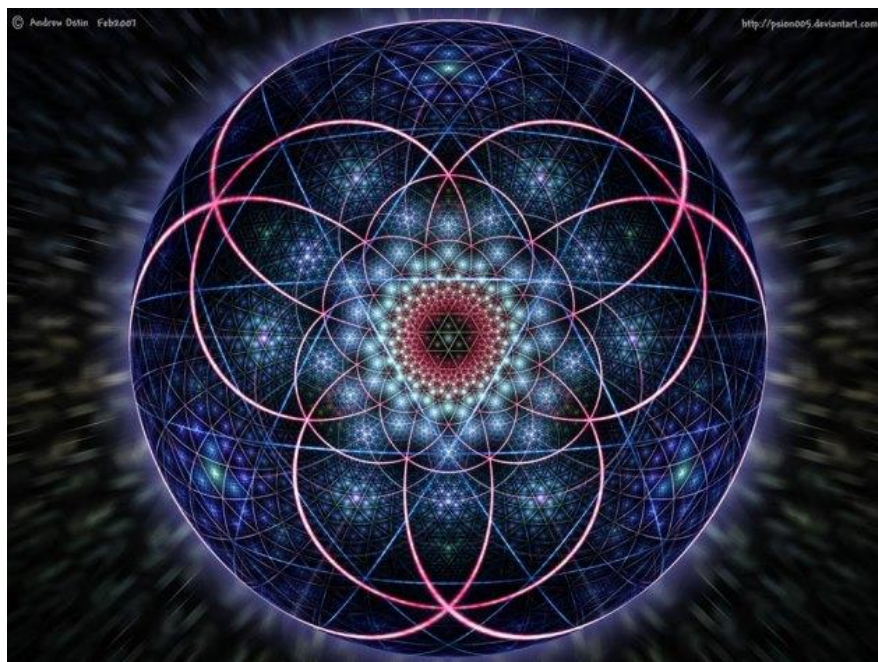


Particle	symbol	charge	rest mass / MeV
electron	e^- β^- e	-	0.510999
positron	e^+ β^+ \bar{e}	+	0.510999
proton	p	+	238.257
antiproton	\bar{p}	-	238.257
neutron	n	0	939.551
antineutron	\bar{n}	0	939.551
neutrino	ν	0	0
antineutrino	$\bar{\nu}$	0	0



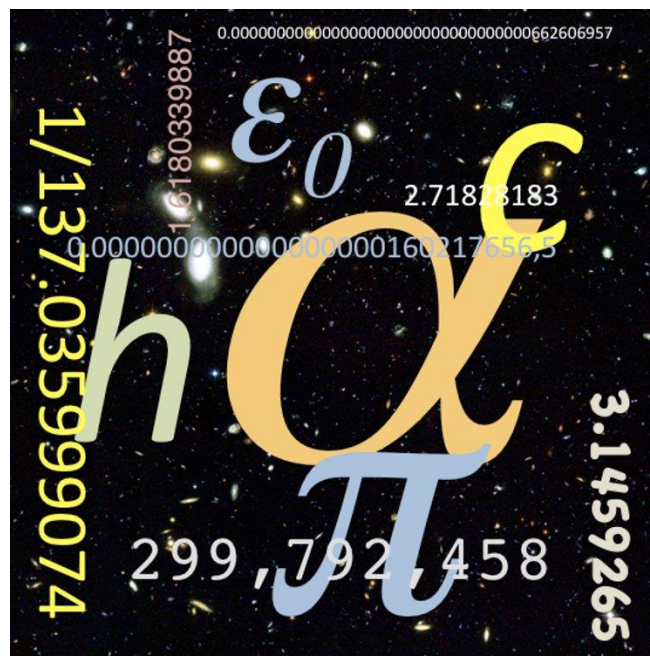
If Geometry defines Gravity and Electromagnetism (united at higher “energies” with weak and strong forces), as Einstein and Kaluza-Klein expounded, perhaps Geometry defines existence, since our existence derives from those fields.

Symmetry is another key to the importance of Geometry in the concepts of Physics. While symmetry is not always maintained (broken symmetries leading to the most important phenomena), the **base** is symmetrical, hinting at a stable, symmetrical undercurrent behind the scene. The Fermion/Boson asymmetry could point to the contrast of coincident/disjoint geometrical structures. Clearly the inverse square laws of Gravity and Electromagnetism reflect (require) a 3 dimensional space and con-committant symmetry. It is that Symmetry that provides the Unity in a Diverse world. A part of this symmetry is the “Net-Zero” balance of the universe... nothing from nothing leaves nothing, as the ditty says.



Another clue that can and should be used to derive the math of what follows is the identity of results from Lorenzian contractions and the results of Special Relativity. The Ether interpretation maps somehow to the “Relativistic” corrections, the propagation/geometric properties implying both views. The resulting basic theory should provide both views an equal platform. The “speed” of light, and the Ether presence (in a new form of course) should come out naturally from the process. Fields in the Ether, properly interpreted as space variations and geometric propagations, would map to our current QED theories, the quantum aspects derived from the discreteness of space and motion.

While many celebrate Einstein for abolishing the Ether, the actual language of “warping of space-time” assumes something there to be warped. That something may not be corporeal as such (much of the Universe is empty), but its effects (when warped!) are real and felt. Space may not be absolute as Newton thought, but it is pretty close in an Empty Universe today, with local twists and turns providing a place to stand on. That “Fabric”, self-built and propagated, lies at the core of Quantum Loop Gravity theories.



The three main constants in physics, c , h and G are conversion factors of sorts for the effects of space. Energy is proportional to frequency (oscillations in space), and the conversion factor is h . c is the conversion factor between distance and time. And G relates space curvature to the density of energy.

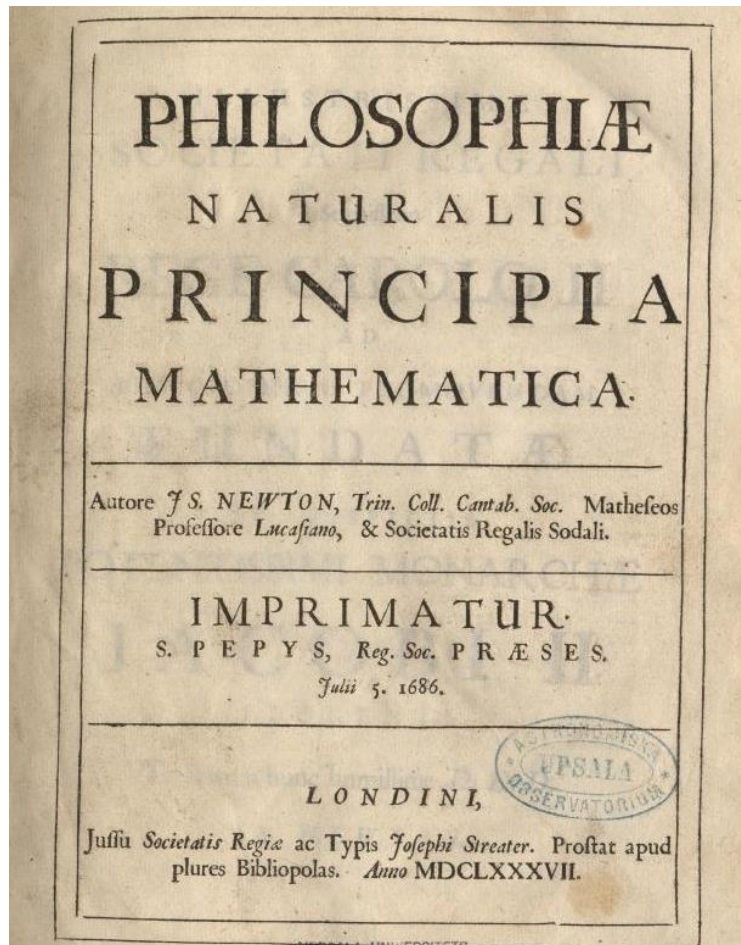
All of our Gauge Theories speak of geometry and symmetry. Geometrical invariances of the laws of nature are equivalent to physical invariance and laws of conservation. For each symmetry, there is an associated conserved quantity. The invariances under local Gauge symmetry dictate the nature and type of forces between particles. The Gravitational field is a necessary outcome of the invariance built into General relativity: the simple geometric requirement that all observers see the same laws of physics irrespective of their motion. The undulations of space define the “straight line” paths of motion, while the actual curvature represents the mass, and the effective motion simulates the effects of virtual “forces”. Geometry (of Space) and Mathematics rule.

Our “Theory of Everything” will be a “Theory of Nothing”, since its core component is a balance between existence and non-existence, a net balance between logical opposites. It starts as Nothing, and as it grows, still balances out to Nothing. But this Duality of opposites can build some very intricate structures, while still balancing out. We live in that intricate structure.

The transformations of particles into waves, something “we are more or less used to” (Perrin, on De Broglie) “when an electron hits a target and it produces an X-Ray”, is more fundamental. It is not a “transformation”, since the “particle” was already a “wave”. What was “transformed” is the geometry of its propagation. $E=mc^2$ teaches us that mass is “frozen” energy, and you can’t really “freeze” energy.

Heisenberg, observing the divergences of S-Matrix theory and other field theories at short distance, had suspected as early as the 1950s that quantum theory would not be valid in spacetime ranges below a fundamental length. A more fundamental theory was needed, “a pure algebraic description at the foundation which avoids the spacetime-dependent fields altogether at the outset, but prepares their effective appearance” (Hans-Peter Durr).

Once we can define rigorously the mathematics of the interactions of the basic components, leading to basic physical elements (basic particles) and concepts (motion, mass, space, time, forces), then we can cover-up that layer and proceed hence with the wealth of information about how those systems interact at a macro level that has been developed by our champion heroes. As Newton proposed, we would derive a few basic principles, from which the “Properties and Actions of all corporal things follow”.



"God Ever Geometrizes" –Plato

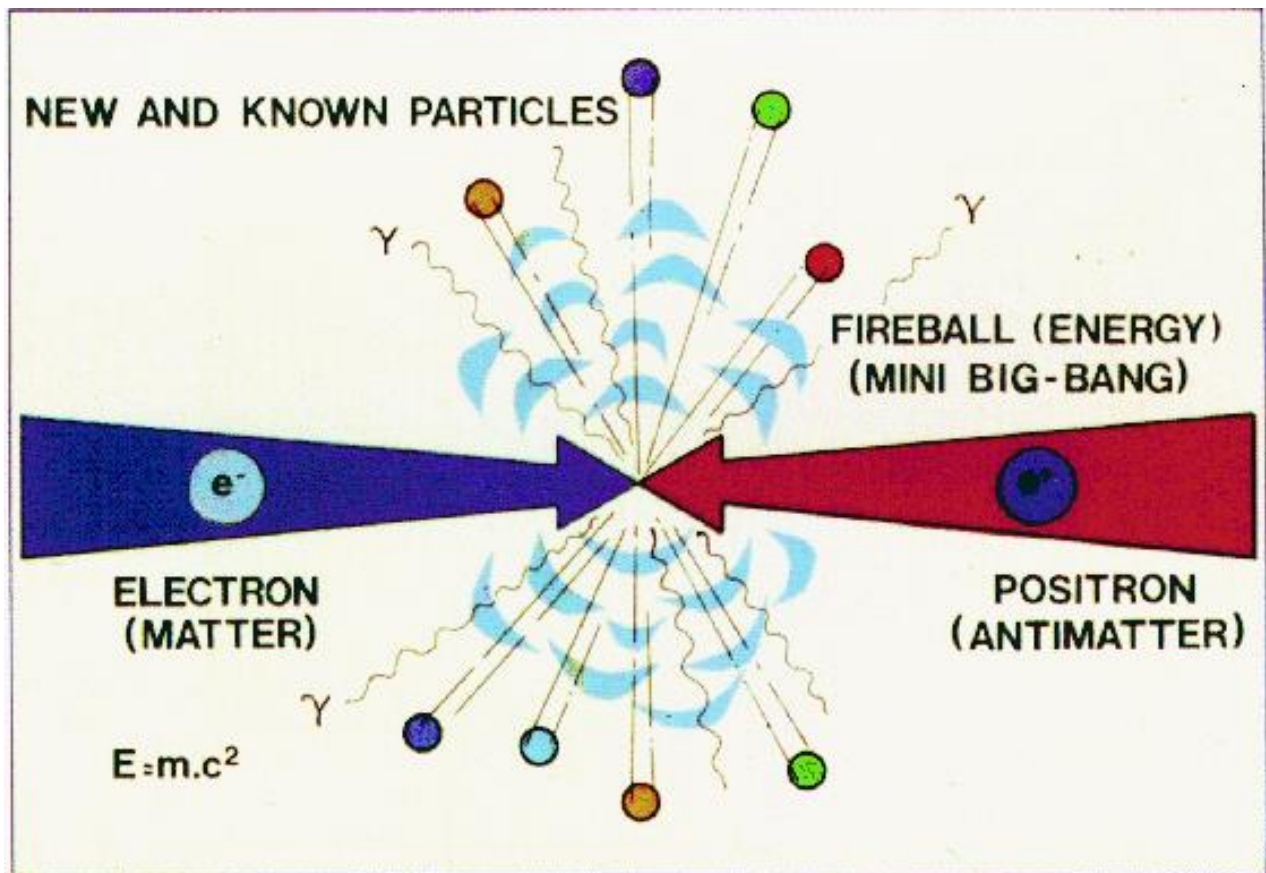
"He who undertakes to deal with questions of natural sciences without the help of geometry is attempting the unfeasible." – Galileo

"Philosophy is written in this grand book, the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of Mathematics, and its characters are triangles, circles, and other geometric figures without which it is humanly impossible to understand a single word of it; without these, one wanders about in a dark labyrinth". – Galileo Galilei (The Assayer)

"... geometry and physics are equal in rank, comprising one science resting upon a common foundation." – Hilbert

"A century's exploration leaves us with the impression that existence, at its core, has a strong geometrical flavor". – Marburger

"goemetria est archetypes pulchritudinis mundi" (geometry is the primordial image of beauty) - Kepler



QUARKS		
<div>u</div> <div>up</div>	<div>c</div> <div>charm</div>	<div>t</div> <div>top</div>
<div>d</div> <div>down</div>	<div>s</div> <div>strange</div>	<div>b</div> <div>bottom</div>
LEPTONS		
<div>e⁻</div> <div>electron</div>	<div>μ⁻</div> <div>muon</div>	<div>τ⁻</div> <div>tau</div>
<div>ν_e</div> <div>electron-neutrino</div>	<div>ν_μ</div> <div>muon-neutrino</div>	<div>ν_τ</div> <div>tau-neutrino</div>

3.1 - HINT... HINT...

“I like simple pictures because I am a simple person myself.” – Rutherford

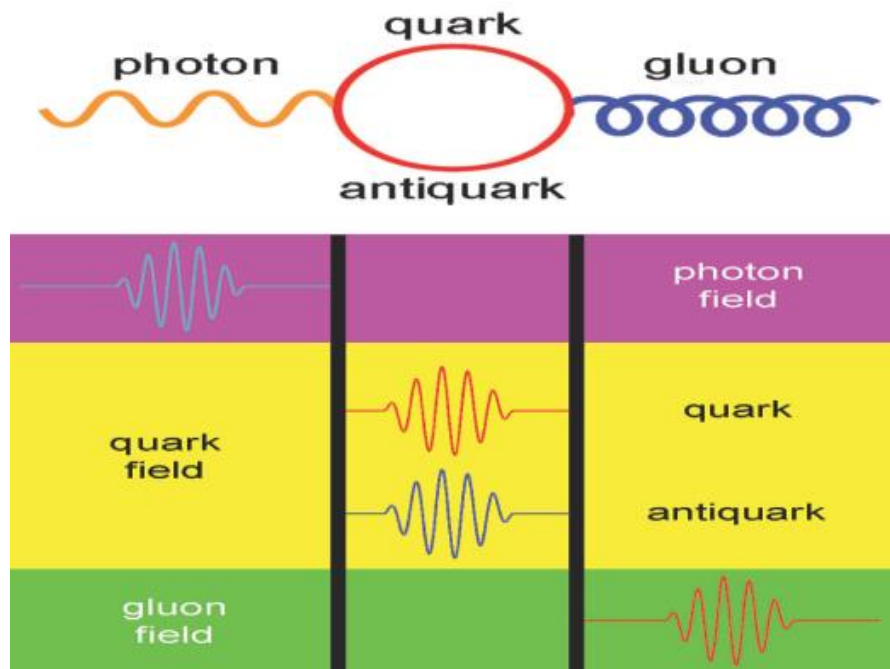
One way to look clever is to take the hints the world throws at you. And Nature is a generous hinter, or at least a bad poker player.

What follows in this book took advantage of Nature’s and Man’s openness. Here are a few of the threads picked up and followed:

- Everything started with Energy. All scenarios, biblical and scientific, start with “Light”, Fireball, or equivalent Big Bang evolution from a primordial energetic beginning. Matter and stuff comes later... 7 days or a few seconds is a detail. But everything was Energy at some point.
- Everything still looks like Energy. An Electron and a Positron “particle/stuff” meet, and turn into energy. A Photon’s energy can turn into an electron and a positron. Take a look at a Z particle decay at the old LEP or the new LHC, and watch it turn into quarks, antiquarks, electrons, positrons, photons, muons, and what have you – as long as they use less “energy” than it has, they can come out of its bag. Clearly, the simple hint is that they are all energy of sorts, packaged differently.
- As we step up or down the ladder in size, everything seems to repeat. An atom is a miniature solar system. The Galaxies and Quasars and Blackholes are similar whirling macro systems. Go inside the atom, into the Nucleus, and you see Quarks whirling around each other, and inside them perhaps Preons whirling around each other in turn. It seems a basic set of laws drive similar behavior at all scales. The equations for Photons and Phonons look almost identical. Einstein-Bose statistics for photons were derived from Gas Dynamics. Condensed Matter physics repeats at every level.
- It also seems that the world is discrete. As we go down the scale, we hit fundamental limits. Spin is either up or down, not midway. Planck limits seem to point to a Digital, Discrete world.
- So we have a digital world, with definite Laws (in a Digital world, that translates into Logical/Mathematical rules), where everything is made of “Energy” at all levels. Maybe there is a fundamental smallest bit of this energy, and the rules are applied to it and a large number of its cohorts. Since it is a Digital world, this smallest bit is just that – a BIT, a logical bit.
- Take that bit, and now look at the laws and the world with that perspective. Could it build up from this scenario? This proposal says yes. Many other

philosophers and Scientists have thought along similar lines, in slightly different ways for sure, but with a similar message in mind.

- Is it the Truth? I do not know. But to be honest, no one really knows. Just read the discussions of the recent Solvay conferences, where the greatest minds of the world meet. Couched in all the technical jargon is a hidden message: “We have no Idea.” Well, here is one idea.



“... further investigation shows that this object is not solid and eventually discloses an atomic structure. The solid object now reverts in our thought to the category of an appearance, while the essence is the set of atoms of which it is constituted. However, deeper studies then showed that even the atom is an appearance and that the essence is a nucleus surrounded by moving planetary electrons. And later still even these particles were seen to be appearances, while the essence was a set of more fundamental particles such as quarks, gluons, preons, or else sets of excitations of strings, etc. But in all of this development of our knowledge, it seems that whatever we have thought of as matter is turning more and more into empty space with an ever more tenuous structure of moving elements. ... What has been constant in this overall historical development is a pattern in which at each stage, certain features are regarded as appearance, while others are regarded as of an essence which explains the appearance on a qualitatively different basis. Ultimately everything plays both the role of appearance and that of essence”. – Hiley & Bohm

“In essence, Nature is simple”. - Yukwa

3.2 - THE "PARTICLE"

***"In the Beginning God Created the Heaven and the Earth. And the Earth was without form, and void; and darkness was upon the face of the Deep."
Genesis 1:1***

"And God said, Let there be Light: and there was light." Genesis 1:3



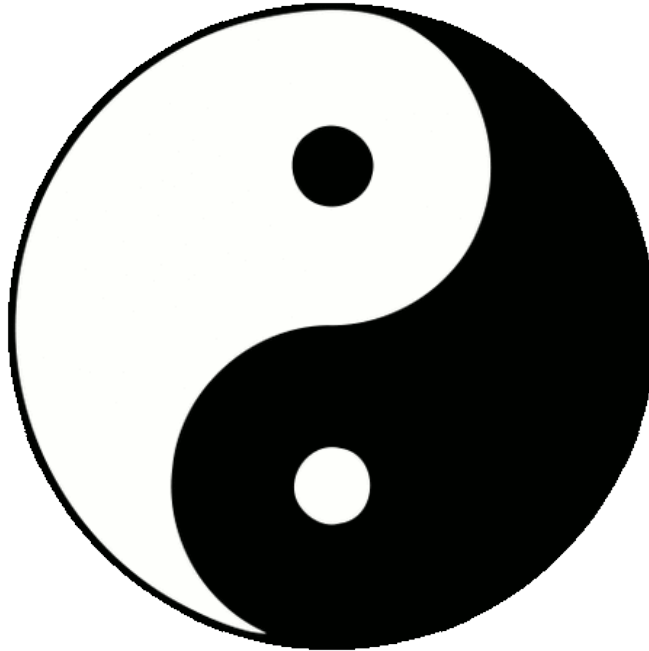
We propose that a Photon is a package of ProtoLight (PL), a ProtoLight (or Photon-Lite?) being the smallest, most elemental bit of anything, the ultimate component in nature.

- The PL is a manifestation of a property of the Vacuum, a digital status flipping between “existence’ and “non-existence”, nature abhorring the vacuum providing the Prime Cause for the oscillations in the emptiness. The nature of this “existence” is the prime substance, if we may call it that, a digital nodal feature that is the “atom-indivisible” of nature – Feynman’s X-ons. It is the single creation ex-nihilo input to this concept – A Logical construct of existence being an inevitable logical imperative, the Yes/No answer to a question, Heads/Tails sides of the coin. Its “substance” is its own logic, its own existence. It is the Logical Ylem – the Absolute, the One, the emptiness, the ground of being – Leibau’s

“Ineffable Unity”. It is not Matter, not yet Conscious Mind, Not dead, Not living yet. It is the Logos, the anti-chaos, the Ch’i (literally “gas” or “ether”) of the Tao – the vital energy animating the world. Our “Things” spring from it as logical instances- the Buddhist Samskara (“events”) of old.

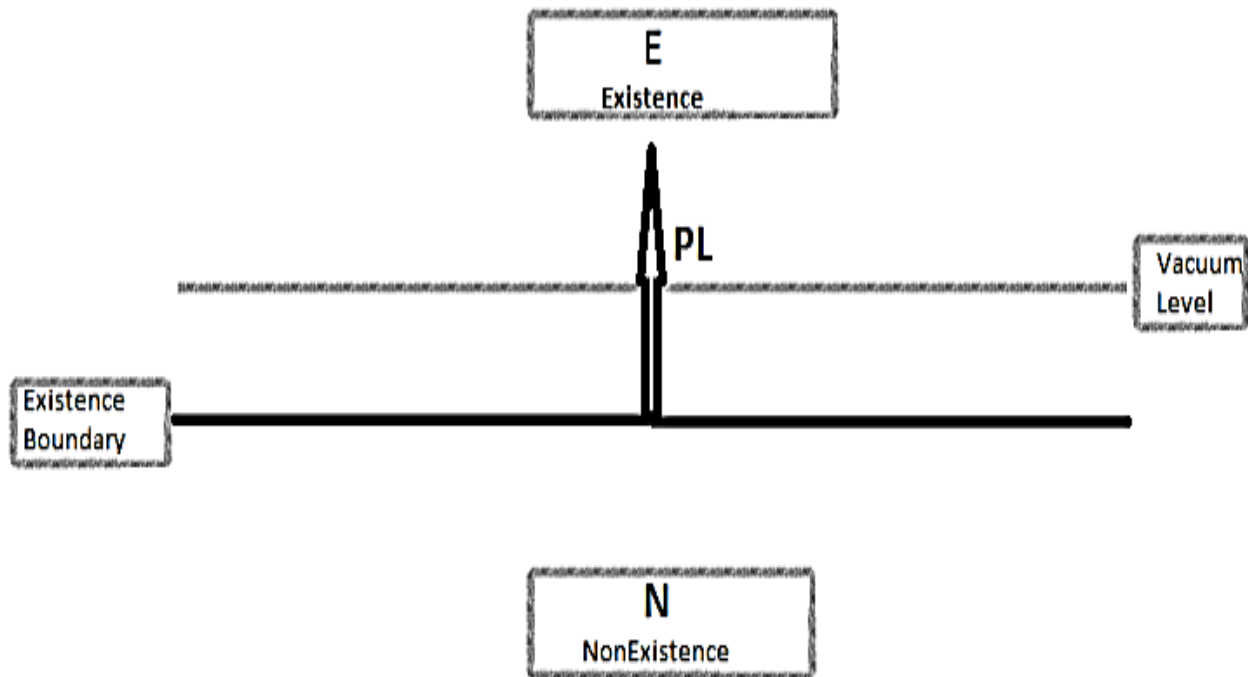
- The “Energy” (or equivalent Mass) associated with this PL, its “signature”, is E, a unit of “Existence”, related to h (Planck’s constant in appropriate units; Planck’s constant = $6.62606957 \times 10^{-34} \text{ m}^2 \text{ kg / s}$).
- Our PL bears a resemblance to Penrose’s Spinors, spin up/down equivalent to the existence logic, with simple arithmetic as their tool.
- The anti-thesis of this PL is non-existence, the anti-PL, which is not the same as Nothing. An interesting observation from Physics: the Universe adds up to NOTHING, with its total energy as Zero (mass and energy balancing gravity’s negative potential – Tod; Penrose) – the Ultimate Free Lunch, says Guth. So it started from nothing, and still is NOTHING. A very interesting, complex arrangement of nothing, but still nothing. We are on a planet that is part of this complex nothing. Meanwhile, the quantum Vacuum we do not see is a sea of energy that is anything but empty, providing the Dark Energy currently exploding our universe. Leibniz asked “why there is something rather than nothing” – well, the answer is, there is nothing (overall).
- Non-existence is much harder to explain than existence. NOTHING is a pretty complex concept in itself. Zero was not known to the Greeks or Romans... It took the Indians and Arabs to introduce it pretty late into civilization (first documented in 876 A.D.). The concept of the Vacuum drove some Greek Philosophers crazy... some even denied the possibility of motion or existence based on it. NOTHING is pretty hard to understand. So if a potential nemesis tries to insult you by saying you know NOTHING, be proud. A better insult would be the slang “you don’t know nothing”- there’s street smarts for you! ☺
- Nature abhors a vacuum, and not just metaphorically. The Quantum “vacuum” seethes with Energy. It seems the Ying and Yang of mythology are always there, balancing out of opposites, giving a “Zero”, “Vacuum”, or “Emptiness” that is deceptive. The Buddhist concept of non-duality, or the Taoist notion of “the identity of the opposites”, sees this “belief that dualism or dichotomy are illusory phenomena”. Polar opposites are inseparable, like the poles of the earth or a magnet, faces of a coin. The

interface between inside and outside, the walls of the box, are also a significant element in their relationship. As Alan Watts says: “the axis of opposites is the perception of polarity. The difference between them is explicit, but the unity is implicit.” As Frank Wilczek says, “the answer to the ancient question “Why is there something rather than Nothing?” would then be that “nothing” is unstable.” Many Philosophers argue that nothing naturally engenders something.



- Being and Non-Being, purely logical opposites, ultimately creating harmony. It is not made of “something” or “anything”, but a logical conception. “In the Beginning, there was the Word”. Einstein, in his musings on Quantum mechanics and its discrete energies and finite Quantum numbers, wondered whether we should not seek an “Algebraic” theory for the description of reality. “Our experience hitherto justifies us in believing that nature is the realization of the simplest conceivable mathematical ideas. I am convinced that we can discover by purely mathematical constructions the concepts and the laws connecting them with each other, which furnish the key to the understanding of natural phenomena.” Perhaps Wigner’s amazement at “the unreasonable effectiveness of mathematics” is not so amazing, when we consider the world as a mathematical construct. Mathematics being about relationships, and relationships being the essence of

existence – no color, no image, no form “exists” on its own, except in relationship to others.



Proto-Light (PL)

- Once a space point exists (is created by the PL), its “energy” “level” oscillates between the E and N (Non-existence) level, providing the “average” energy of the “Vacuum” when viewed “succeedingly” (both “average” and “succeedingly” to be defined later).
- Those oscillations would have no direct measurable properties, since the duration of their click is measured by their clicking, our observations controlled by the clicking, hence defining Time and not able to be defined by it.
- Similarly, their location in space is measured by “relationships” between virtual points in the vacuum/nothingness, and so defining “Space”, and not defined by it. The virtual 3-D space we perceive would be a reflection of the “relationship” aspect between the interacting parts, not a reality, but a framework for our perception which is entangled with it. Understanding the framework could explain the reality-observable disconnects in Quantum Mechanics, and the apparent entanglement over large distances that may not be so large in the framework (Holography as an example). “Complexity is but the many faces of simplicity” (Lebau).

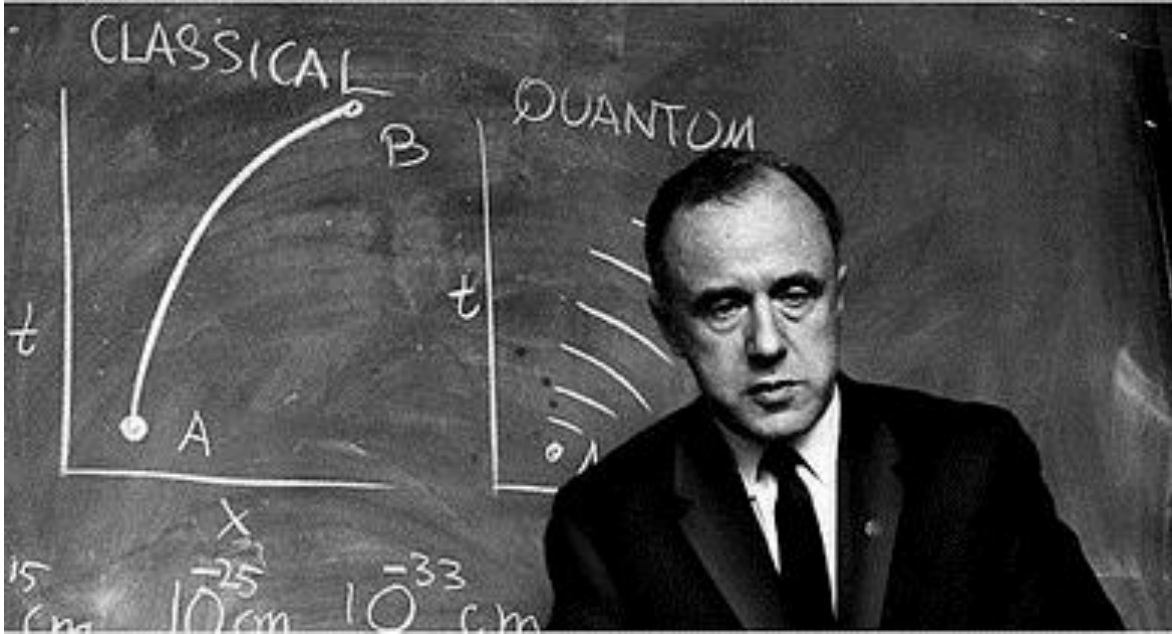
- The fact that a minimal requirement for the PL and corresponding node to exist is the transient oscillation of $E(h)$, provides the uncertainty limit of all Energy/time observations.
- The various configurations and travel modes of this PL, and their inter-relationships to each other, come together to present to us the view we see as reality, the “appearance” imparted by their presence on our senses – the “Cultivated Third”, simplicity unfolding to complexity, a cellular growth process of multiplication-through-division. They combine to form “particles”, “light”, “space”, “mass”, “charge”, “time” and the general framework we need to get on with the well-established Classical, Relativistic and Quantum sciences. Reality of a particle is only complete in relationship to the rest of the Universe- the relationships themselves defining it- in fact ARE it. The “Shards” of space and time, created initially as islands of interaction, start to coalesce and build a larger set of relationships. The “relationships” built up by the multiple instances lead in their infinity to the complex world we observe. “Before” this, we have no space or time – a structureless, raw state, very difficult to imagine – we are the creatures of the relationships, and have difficulty imagining a world without them.
- The Digital nature of existence spawns an identity between physics and mathematics- Nature as “information”, Universe as digital computer writ large, with randomness injected at the source. M. Strauss derived the formalism of Quantum Mechanics from the structure of Complementarity Logic. Others following deduced it over fields of reals and Quaternions, in addition to Complex Numbers. Wheeler, always quick with a phrase, called it “IT from BIT”, proposing an immaterial Universe. Bekenstein insisted “a final theory must be concerned not with fields, not even with spacetime, but rather with information exchange...”, asking: “is the entire Universe a computer program? Are we just bits on a cosmic CD?”.
- Guccione summarizes: “It is possible to propose a thesis according to which the physical Universe is viewed as a (the?) computer: “...no time, no space, and no law. The building element is the elementary ‘yes, no’ quantum phenomenon. It is an abstract entity. It is not localized in space and time.”” In this view, physical processes are viewed as computations.
- Paolo Pizzi’s Quantum Computer View (QCV) proposal (and similar proposals by Lloyd and Jaroszkiewicz) assumes space-time as discrete,

quantized in planck units, and “Qubitized”, with each pixel of planck area encoding one Qubit. In this view, quantum space-time is viewed as a computer. “Quantum spacetime itself is entangled, and can quantum-evaluate Boolean functions which are the laws of physics in their discrete and fundamental form”. It takes inspiration from various discrete space-time approaches like Loop Quantum Gravity (including spin foams and lattice versions), String & M theory, non-commutative geometry, Causal Set Theory, and Cellular Networks.

Based on Wheeler’s “It from Bit” proposal, where information theory is the key to the foundations of physical reality, it also echoes Zeilinger’s view which associates bits with elementary (two-level) systems – leading to a quantized world since information is quantized. Quantum Spacetime is entangled, leading to non-local aspects and superpositions (simulating “many worlds” scenarios). Events basically encode quantum information, and the “holographic principle” is emergent (a-la Loop Quantum Gravity and Spin Networks) where each planck area pixel is associated with a bit/qubit of information. The Qubits correspond to the surface of a 3-dimensional unit sphere (Bloch Sphere) where the logic states 0 and 1 correspond to the poles.

Quantum States are seen as the state of a quantum computer which is computing Boolean functions, the laws of physics. Superposition is seen as a condition where the qubits encoded by pixels are superposed, with the surface embedding a region of space existing in many different states simultaneously – “Many Worlds” but retracted to the “micro-domain”. Spacetime is also non-local due to entanglements of pixels/qubits, in line with Penrose’s expectations of spin networks. The Quantum Computations would make use of Hadamard logic gates built into the spacetime network. With a cosmological horizon of around $R = 10^{60}$ lp, and a surface area of the order of 10^{120} lp², an area of 10^{120} pixels, each encoding a qubit, represents the Universe’s Quantum Computer’s quantum memory register. The linearity of the planck scale operations can result in macroscopic non-linearity with the emergence of complexity and self-organizing models.

If Gamow was around, he would call this the “Digital Ylem”.



John Wheeler

- Wheeler's GeometroDynamics was on the right track: an attempt to describe spacetime and associated phenomena completely in terms of geometry -mass without mass; charge without charge; field without field – Pre-geometry as a binary-choice logic. Wheeler's "sewing machine" connecting rings or loops in space based on their binary (yes/no) status.
- C.F. von Weizsacker, in commenting on Dirac's Large-Number Hypothesis, proposed "simple alternatives" as ultimate objects of the world, "trivially possible as long as we leave their law of interaction indeterminate". These "urs" (from German 'uralternative') can be seen as two valued variables, forming a Hilbert space consisting of a complex vector whose symmetry group consists of $U(2)$ and complex conjugation (which is described by introducing anti-urs). "Systems of urs will best be described by (Spinor) functions on the Symmetry group", and those functions automatically generate cosmic space "as its natural representation space". In calculating how baryons and other particles could be built from this scheme, he calculates a baryon localized to within 10^{-13} cm requiring 10^{40} urs, and hence implying around 10^{80} such particles, our current estimate of particles in the observed universe. (Note the numbers in the range of our PL estimates for particles in the appendix).

While one might argue against Dirac's hypothesis (as Wheeler amusingly did, suggesting that instead of following the flood to clean it, we "turn off the faucet" and the flood would stop ☺), or Pascual Jordan's "Expanding Earth" followup, one must wonder how such great minds agreed on such a proposal, which carried in it the germ of many useful ideas (such as the distinction between atomic time and Einstein time, and the potential for a granular, discrete view of the universe, with continuous creation in addition to the big Bang).

Still, Weizsacker's idea sounds very close to our PL concept. He saw an increase over time of those urs (an 'expression of the fact that only finite questions can be answered at any time but that more questions can be asked in the future'), leading to an expanding Universe. He saw the creation of an ur as Finkelstein's 'chronon' (discrete time-event). Gravitation follows as the curvature of space, by definition, while the SU(2) symmetry produced a 3D space, with Lorentz symmetry emerging from the large scale view of the mode, with appropriate Lorentz Transformations used to define distance and time.

While the details of Dirac and Jordan's ideas may be wrong, Weizsacker's angle is very close to modern views of pre-geometry, and is a good match with our PL concept. Additionally, ideas of continuous matter creation can be tied to "Dark Matter" formation and 'ur' creation. Atomic time versus Einstein time can be mapped to conformal time and proper time, again providing an ontological view of relativity and spacetime.

- Riemann aimed at understanding the physical world by developing a deep understanding of Space, and for Riemann Space meant Geometry. His "crumpled Hyperspace" would have explained "force" and anticipated Einstein by 50 years, but Death had other plans. Plato saw Physics as Geometry, Pythagoras as numbers... both were perhaps right.

A new "Complementarity" is proposed: While existence is tied to logical entities, driven by an innate logic in an entangled Netherworld, their emanations coalesce into the physical world we "perceive". Once we can envision how those logical entities can simulate the basis of reality (Electron, Photon, Space, Time), we can then proceed with our analysis using the "Complementary" view of Physical law we are familiar with.

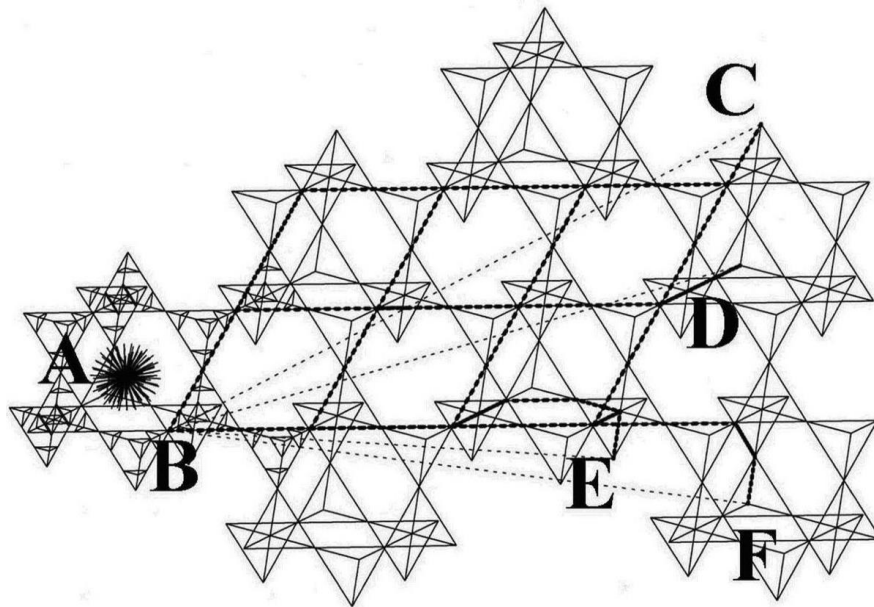
As Bohm says, “there is a similarity between thought and matter. All matter, including ourselves, is determined by “information”. “information” is what determines space and time”. The PL we propose has no properties but its existence, and even that is only obvious when compared with “non-existence”. Everything else is emanent from relationships.



Since reality and our Physical world are made of huge multitudes of PLs, the complementary view of Nature is easier to use. We cannot describe complex interactions using a PL equation anymore than we can describe a baseball game by writing the QM equations for every molecule in the bat and ball. We recourse to the PL view to explain those aspects that our Physical intuition denies, like Entanglement, Non-locality, and the reality-existence dilemma. But throughout our analysis, we cannot ignore the fact that the “particles” and “structures” in questions are logical constructs in Hilbert Space, correlated by Algorithms, and that their apparent Physical emanations are still ruled by those entangled rules.

The Mahayana Buddhist Avatamsaka Sutra sees the world as a perfect network of mutual relations where all things and events interact with each other in an infinitely complicated way. This is our PL world of infinite complexity. It is Heraclitus’s “everlasting fire, kindling in measures and going out in measures”.

As Frank Tipler puts it: “it would seem that indeed the universe is a mere expression of mathematical reality, more specifically an expression of number theory, and of integers to boot”, echoing Kronecker, who said “God made the integers, all the rest is the work of man.” Reality is not ultimately “Real” – only number – the integers comprising the true ultimate reality – is actually real – a mathematical, logical reality. If we can imagine our world as a possible digital simulation on an alien computer, we should be able to imagine, like Feynman, the universe as an actual computer on auto-pilot.



“Nature’s fundamental laws are defined at the Planck scale. At that scale, all we have is bits of information”. – Gerard ‘t Hooft

“The unrest which keeps the never stopping clock of metaphysics going is the thought that the non-existence of the world is just as possible as its existence”. - W. James

“When one dives into endlessness, in both time and space, farther and farther without stopping, one needs fixed points or milestones past which one speeds. Without these, one’s movement does not differ from standing still. There must be stars along which one shoots, beacons from which one can measure the road covered. ...He must divide his universe in distances of specific length, in compartments that repeat themselves in endless series.” – M.C. Escher, Approaches to Infinity

“There may be no such thing as ‘the glittering central mechanism of the universe’ to be seen behind a glass wall at the end of the trail. Not machinery but magic may be the better description of the treasure that is waiting. Rather than Newtonian law it may resemble more the logic of relationships that Leibniz envisaged.” – John Wheeler

“In the beginning there was nothing. Absolute void, not merely empty space. There was no space; nor was there time, for this was before time. The Universe was without form and void. By chance there was a fluctuation and a set of points, emerging from nothing and taking their existence from the pattern they formed, defined a time” – Peter Atkins

*“For thou wilt mark here many a speck, impelled
By viewless blows, to change its little course,
And beaten backwards to return again,
Hither and thither in all directions round.
Lo, all their shifting movement is of old,
From the primeval atoms; for the same
Primordial seeds of things first move of self,
And then those bodies built of unions small
And nearest, as it were, unto the powers
Of the primeval atoms, are stirred up
By impulse of those atoms’ unseen blows,
And these thereafter goad the next in size;
Thus motion ascends from the primevals on,
And stage by stage emerges to our sense,
Until those objects also move which we
Can mark in sunbeams, though it not appears
What blows do urge them.”*

Lucretius – “De Rerum Natura”

"Could it be that the real world consists of little X-ons which can be seen only at very tiny distances? And that in our measurements we are always observing on such a large scale that we can't see these little X-ons, and that is why we get the differential equations? ... Our currently most complete theory of electrodynamics does indeed have its difficulties at very short distances. So it is possible, in principle, that these equations are smoothed - out versions of something. They appear to be correct at distances down to about 10-14 cm, but then they begin to look wrong. It is possible that there is some as yet undiscovered underlying "machinery", and that the details of an underlying complexity are hidden in the smooth - looking equations - as is so in the "smooth" diffusion of neutrons. But no one has yet formulated a successful theory that works that way." - Richard Feynman, "Feynman Lectures of Physics".

"Elementary particles existing in nature resemble very much excitations of some complicated medium (Aether). We do not know the detailed structure of the Aether but we have learned a lot about effective Lagrangians for its low energy excitations. It is as if we knew nothing about the molecular structure of some liquid but did know the Navier-Stokes equation and could thus predict many exciting things. Clearly, there are lots of different possibilities at the molecular level leading to the same low energy picture." - Alexander Markovich Polyakov

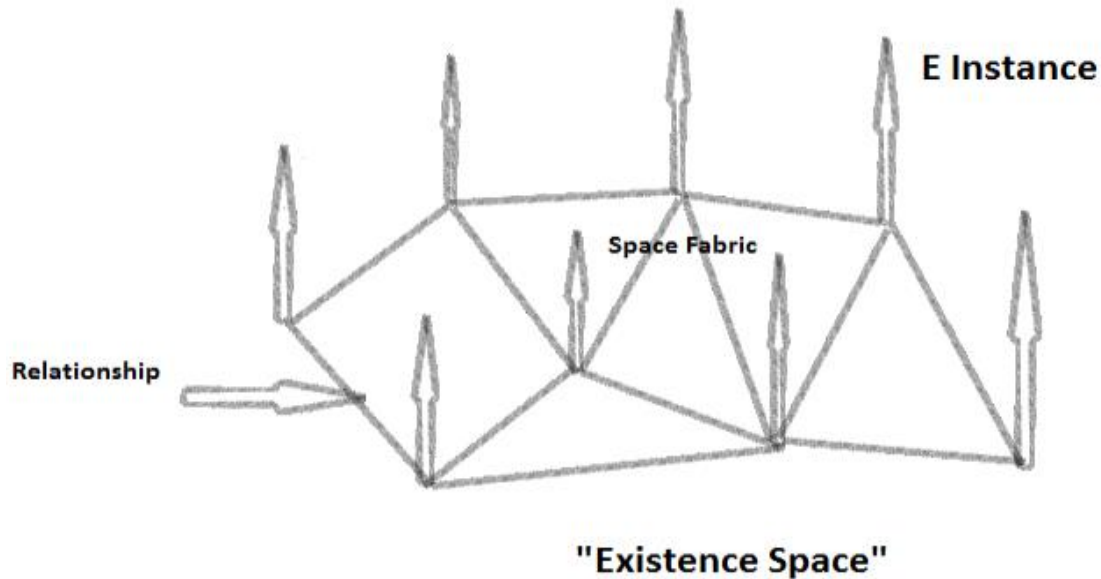
"To me, it seems extremely plausible that any reasonable theory for the dynamics at the Planck scale would lead to processes that are so complicated to describe, that one should expect apparently stochastic fluctuations in any approximation theory describing the effects of all of this at much larger scales. It seems quite reasonable first to try a classical, deterministic theory for the Planck domain. One might speculate then that what we call quantum mechanics today, may be nothing else than an ingenious technique to handle this dynamics statistically."

- Gerard 't Hooft (ideas later confirmed by Blasone, Jibza & Kleinart)

"I would like to make an attempt to give a name to that which the new idea of reality beings to my mind: The idea of the reality of the sumbol". - Pauli

Takeaway: The Universe is a logical construct, with the Proto-Light (PL) as its fundamental "particle", created ex-nihilo. The inter-relationships between these PLs create space, time, matter and energy.

3.3 - SPACE



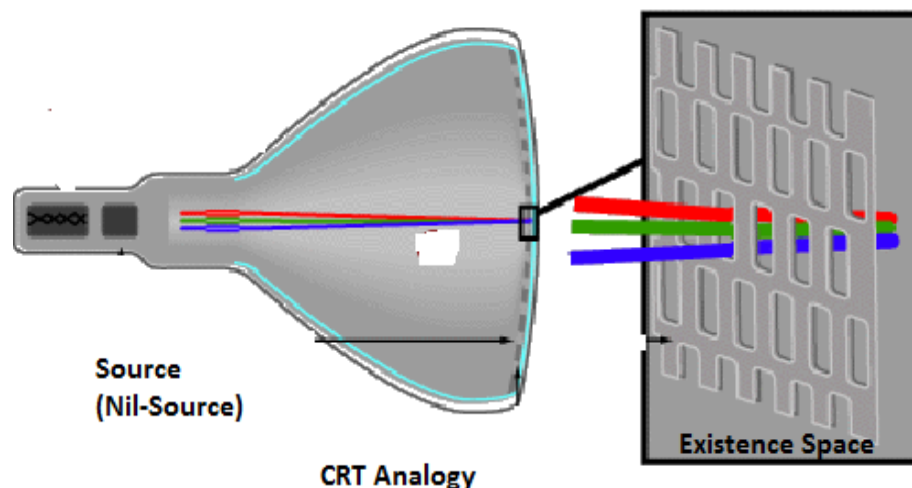
- The inevitable Existence of PL instances would tend to create an Existence field, a Hilbert “Space” for E, an “Existence Space”, Smolin’s “atoms of space”. As More said, God and Space (God’s Omnipresence) have the property of necessary existence (his conclusion: they are one). This would be initially an infinite dimensional, initially random, space.
- This Hilbert Space (so named by John von Newmann (one of those extraordinarily gifted Hungarians who came to America from Europe, rumored by many to be extra-terrestrials due to their incredible gifts and strange tongue ☺) when explaining it to Hilbert) replicates via the geometry of vectors over the complex plane the same formal properties of the states of a quantum mechanical system. Those little vector arrows can be manipulated, representing mathematically significant qualities of our physical world. Schroedinger’s equation is a function in this configuration space, not “real space”, as Schroedinger himself pointed out, but we will challenge this view as well.

$$i\hbar \frac{\partial}{\partial t} \Psi = \hat{H} \Psi$$

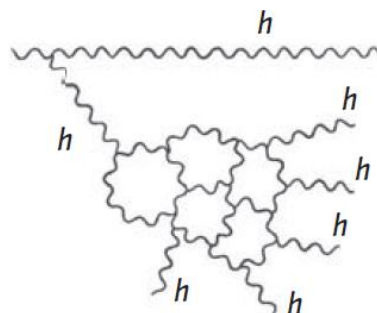
- This space would develop interactions, the Logical N/E disconnect imitating a digital field, with incremental addition, multiplication and other commutative properties. Other non-commutative properties would also emerge, as the mathematical possibilities (including

Quaternions and Vector Operators) expand the inexorable logic, and between the two types, creation and annihilation operators would ensue, ensuring the expansion to infinity of the fabric, creating the entire Universe. (Peter Rowland's "Zero to Infinity" is a great tour on this concept, using the Nil-Potent formalism & a re-write system to build out the logic from scratch, using just one symbol representing "nothing" and two fundamental rules: create and conserve to ensure a zero sum, and develops the entire schema of Dirac's generalized equation, our Standard Model and QM from the concept of Zero-Totality). Relation is essential to matter, and vice versa.

- As von Weizsacker suggested, we do "not have to accept space as given but to construct it. The simplest and most abstract construction will begin with a two-fold alternative, i.e. with one yes-no decision. Multiple quantization starting there would mean to build up the objects in the world as ensembles of such decisions. The number corresponding to one object would mean the number of decisions needed for fully defining the object. Now the quantum mechanics of an ensemble of two-fold alternatives nearly automatically leads to a description in a three-dimensional real space and hence in the higher steps to the usual field theories in three-dimensional space. Mathematically this introduction of space corresponds to Schwinger's introduction of angular momentum by a Bose-ensemble of spin $\frac{1}{2}$. It has been studied by Penrose and essentially by Finkelstein who introduced the discrete counting of time ('chronons') as the basic idea. A quantum-theoretical construction of space would in the same step lay the foundation for field theory and cosmology. It would thus establish the unity towards which physics is moving. The essential problem is how to define the interaction of the elementary alternatives".



- A good Analogy to this space creation would be a CRT, with us on the screen. The Rays of “Existence” emanating from the “Nil-Source” of Non-Existence, populating our “screen”, our “space”, its correlations creating our “Images”, ourselves. The “Logic” of the CRT source (Correlations in Hilbert Space) would draw out the pictures on the screen.
- Modern String theory proposals include “Computational Unified Field Theory” (CUFT) that proposes a cinematic analogy of “frames” clicking by. A series of “Universal Simultaneous Computational Frames” (USCFs) rapidly paints an image of a moving world, the increments in time, space, energy being in the planck range. Our PL world is similar, but not restricted to simultaneous frames clicking synchronously.
- The relationships between the individual PL instances defining space relations, and creating a space fabric of this mesh- Space being, in Damascius’ words, the numerical measure of position. This network of relationships would ultimately emerge as our “real space” that we perceive. In the words of the ancient Sanchoniathon: *“When this wind became enamored of its own first principles (the chaos)..., this was the beginning of the creation of all things”- Phoenician History*. Spacetime is an approximate concept, valid only macroscopically.
- This Space substrate would have an “average” “existence density”, the Vacuum energy level we see as our Zero energy level. While explaining the “Vacuum Energy”, it resolves the issue of the huge Vacuum Energy disconnect between actual measurements (from Cosmology and the Cosmological constant) and Quantum calculations.
- The fact that a minimal requirement for the PL and **corresponding “consecutive” nodes** to exist is the transient oscillation of $E(h)$, provides the quantization and uncertainty limit of all position and momentum observations. The minimal “length” between nodes also removes the problems with Quantum infinities at small scales, smoothing out the Quantum Foam (a strong claim of String theorists who propose one dimensional strings with Planck length).



Virtual
Propagating
Gravitons

- Perhaps an initial ripple, in the “vacuum”, was the Singularity we seek in a not-so-big “Bang”, which has in its expanding wake created space and ongoing ripples.
- Perhaps the ongoing rippling also causes additional nodes to come into existence, creating the “expansion” of space we perceive. Perhaps the “Vacuum Energy” is the inherent tendency for ripples to spontaneously generate from the logic of emptiness, and that its ongoing “virtual particles” are small “burps” or ephemeral ripples that subside, but in doing so create more nodes that expand the fabric further, causing the uniform expansion we see. This would also explain the fact that the Dark Energy – the “density of Existence” of those nodes, does not dilute with the expansion, since the expansion is the addition of nodes with their own PLs, the “Energy” increasing along with the space it is creating.
- The changing structure of space created and modified by the PL would contain the seed for variability in our “constants” that vary with its geometry and spacing. Ideas about the speed of light varying with the “Temperature” of the Universe would be folded into this concept – Gravitational “constant” variations with overall mass could also be impacted... But the main point is that this created “Existence Space”, once there, can serve as our basis for our “classical” and “relativistic” space, in which standard science can proceed.
- Space at large comes out three dimensional, since all of the relationships (inverse square law, and Quaternion finiteness) demand it. Other dimensions, while possible, are unstable and continue to generate and collapse, remaining invisible. As Mirman indicates, “It is not so much the properties of quantum mechanics and of space that determine its dimensions. Rather consistency requires this set of properties. The dimension of space is thus a consistency condition”. Most models of “pre-geometry” lead to solutions stable only in 3-dimensions.
- The many proposals for additional “virtual” dimensions would impact the geometric picture and hence the properties of the forces described. Gravity, a warping of “space”, would extend its impact into other dimensions, the geometry being linked. Charge and Electromagnetism, being propagations and exchanges in the virtual “space”, would also represent additional dimensions – they may have “cousin” propagations in other dimensions which we would not see, with interesting

properties that we may someday adapt to our benefit, but for all other purposes remain invisible to us. Those dimensions are orthogonal to our 3-D mesh, and the PLs clustering in them represent the particles and photons, which “ride” on the space mesh that directs them. Their “mapping” onto our space (via pilot waves and warp) is what directs their motion and observable effects.

- The various Charges and Colors of electrons, Quarks and neutrinos would represent PL propagations in different dimensions, obeying symmetry laws. For us, who “see” through light, we would only “see” the 3 dimensional world drawn by Light’s rays in our basic 3 dimensions. We do however feel the “weight” of those additional propagations, since they represent PL counts (or numbers) mapped onto our 3-dimensional space from those additional Hilbert Dimensions.
- The Fabric of space would be a flexible, relative system, as Leibnitz, Huygens, and Mach exposed, but in the “classic” limit would still present a quasi-fixed framework to satisfy Newton- his Luminiferous Ether.
- How far apart are two points in Space? Is that a meaningful question? Our “view” of a contiguous world, drawn by Light, may give us a false perspective. Two “points” in space would be two instances of the arbitrary Hilbert Space of existence. Their “Distance” is only meaningful if you try to “travel” between them, in your own “view” of the world. A different kind of “Relativity” sets in. The simplest travel mode is “Light”, which hops the nodes, and by its hopping defines their relationship and defines a straight line of “distance” between them. It creates the framework at the same time as it is traveling, so the distance is created by the act of traveling.



- The “speed” of the traveling is also defined post-facto as the “distance” over “time”, which time is the number of hops (cycles) of the Light, again defined by the traveling. The Distance, Speed and Time are emanent ideas from the act of traveling, and are meaningless without it. When light jumps from one point to another, we consider those points as “adjacent”, while in reality (?) they could be far apart by other metrics of the Hilbert Space. Hence our puzzlement by “Entanglement” when points “far apart” (as the light travels, so to speak) can still interact instantly, when in principle there is nothing to prevent Light (or PLs) from jumping instantly between those two points. Between jumps, the PL does not conceive of distance at all, that concept being our own interpretation of Light’s Photonic causal travel mode that we see, which is not the only way Light travels.

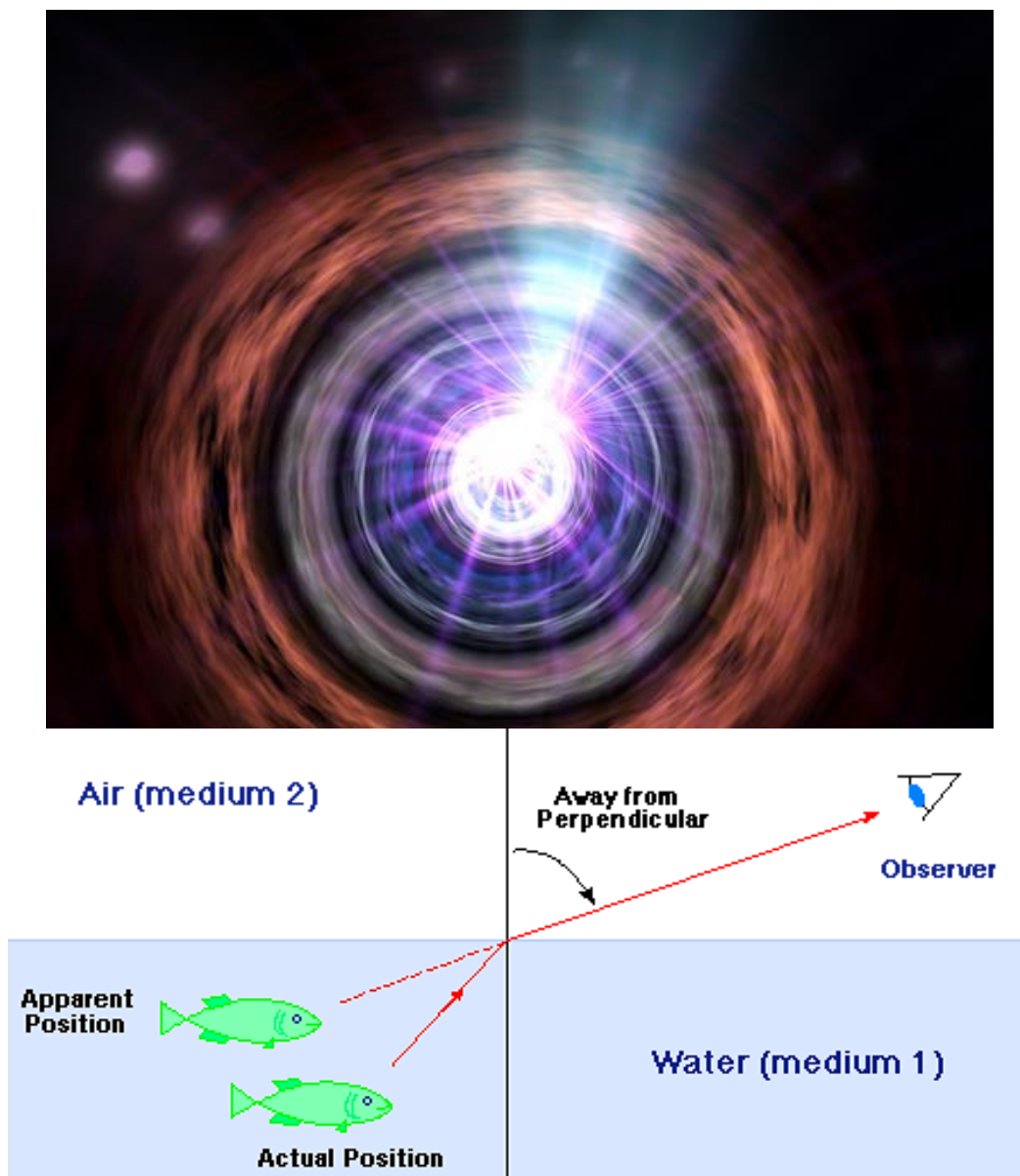


An analogy for the distance, time emanence would be a runner criss-crossing the US, who can only be “seen” at a city, whereas the inter-city “space” is an undifferentiated forest. In that world, people would measure distance as “number of cities” crossed; they would also measure time as the number of times the runner appears. The “Speed” of the runner would be: $S = \text{no of cities crossed} / \text{no of times runner appears}$ (in this case =1, similar to when we choose $c=1$ in appropriate units).

So if the runner goes from NYC to Newark to New Brunswick, he has traveled a distance of “2”. Similarly if he goes from NYC to Chicago to LA, he has also

traveled a distance of 2. (we of course think the distance is more, since we have other ways of measuring the “forest” in between – but in the microworld, there is no way of measuring the Hilbert Space between our nodes).

Similarly, we would define a “straight line” as the sequence of cities traversed by the runner in sequence. So the NYC-Chicago-New Orleans sequence would also look like a straight line in that map. Similarly, Light’s travel draws our straight lines for us. As the artists of the Quattrocento found out, “the organizing element is light – indeed, light creates the space” (Chevalley).



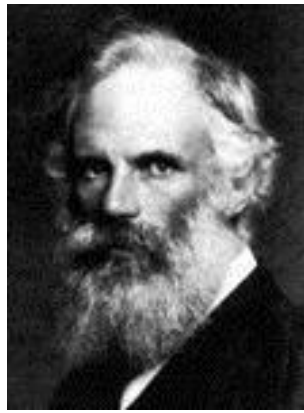
This “relativity” of distance and time, and straight lines, is hard to grasp, but not impossible when you get used to it. An example from real life: When we view an object under water, we “see” it at a different spot than where it actually is. We tend to extrapolate the light coming into our eyes to the location. But since Light “Bends” at the water surface, the object is not where we “think” it is. We take the straight lines of light as a definition of our world, and are confused when light bends. Fortunately, in this case, we have learnt enough (based on the changing position from different perspectives, experiments, etc.) to differentiate this case, but again, in the microworld, this is much harder to see through and measure.

- The PL sheet that constitutes space generates the Metric Field, which describes its geometry, and results in the effects of gravity, EM, and all other perceived “forces”. “According to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense” (Einstein, 1920). This “Grid” of PLs is the substrate of existence. The Gravitational field, and the CMBR, together provide the Ether rest frame and a sort of Universal time – a chosen foliation of the space-time construct.
- This substrate, this “Ether”, is the home of the various “condensate” fields that represent matter and energy. These condensates represent clusters of PLs that form, either as a result of “quantum” fluctuations (spontaneous generations of PLs that take definite forms) or PL aggregates that form particles, virtual or otherwise. Its actions simulate what we call the “Higgs field”, that gives matter its “mass”. Out of it comes the Quark/AntiQuark condensates, apparently coming out of Nothingness, as PL emanations coalesce into formations (and releasing energy in the process, hence favoring their generation – A Quark-anti-Quark pair having an energy BELOW nothingness!!).
- This “Ether” also has a flat density everywhere. This is the explanation of the “flatness” of the Universe. As it is created, it creates space with it, keeping its density the same. Its Mass-density and “pressure” are intrinsic properties of space, because they are Space. This density is Einstein’s Cosmological term, and the “Dark Energy” expanding the Universe. The metric field it generates is the definition of space and time – at the big bang, the spread of this metric field created space and time,

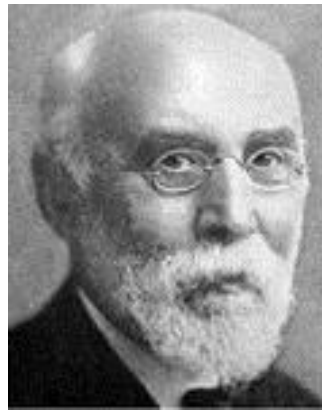
which were meaningless before it. Its material is the material of all our other fields and all of reality. It is a “logical condensate” from the chaos. Its “shape” guides the motions of all the “particles” or “PL Clusters” in it, which we detect as various “forces” – All such clusters moving in “straight lines” (which we circularly define as their natural motion) – EM clusters (light) bending with the warps in this mesh, QCD clusters (gluons) bending with the same warps, and so on for the gravitons and weak forces.



Michelson



FitzGerald



Lorentz



Poincaré



Gauss



Riemann



Grossmann



Hilbert

Giants of Science – some of Feynman’s “Monster Minds”

“... there is a weighty argument to be adduced in favor of the ether hypothesis. To deny the existence of the ether means, in the last analysis, denying all physical properties to empty space. But such a view is inconsistent with the fundamental facts of mechanics.”
- Einstein

Takeaway: The Space mesh is drawn by the travels and relationships of the PLs. An Ether is thus created. Straight lines are defined by the travel paths of PL Clusters (PLCs), aka photons.

3.4 - TIME & SPECIAL RELATIVITY

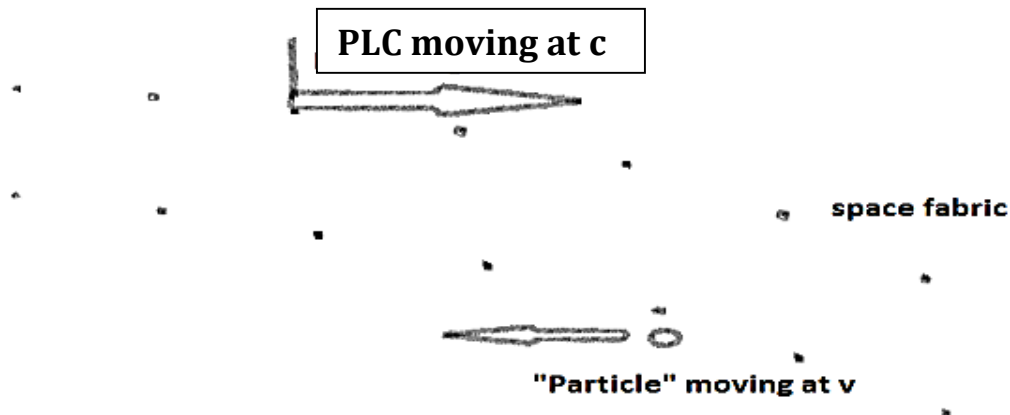
“We have no indirect intuition about the equality of two time intervals. People who believe they have this intuition are the dupes of an illusion.”

– Henri Poincare, *La Mesure du Temps*

Time, in this scheme, would represent a “clock” **relative to an observer** “**watching**” the PLCs hop the space matrix. This of course is only possible in interactions, where “events” caused by PLC motion and impacts are “perceived”, and their causal sequence “timed”. As Aristotle said, Time is the numerical measure of motion. Planck Time, the apparent smallest click:

$$t_P \equiv \sqrt{\frac{\hbar G}{c^5}} \approx 5.39124(27) \times 10^{-44} \text{ s}$$

Now if we consider that a PLC is moving along, “clicking” into Existence between the nodes of the space matrix, then for that PLC, Time does not pass. The Frequency of Clock-Ticks of wavefronts is what **we** see. It does not see its own clicking, since the relative rate of the space matrix clicking to itself is identical. The moving PLC does not “feel” time. (A macro equivalent analogy is the saccades in eye vision, where change is recognized- experiments showing the observer does not recognize change if it happens during a saccade).



Time relation to Motion

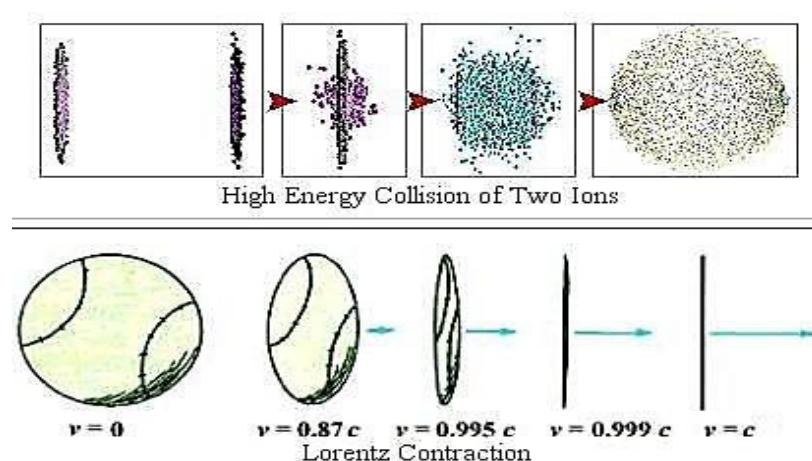
- However, for a particle at rest in the mesh, it “sees” the space mesh clicking at a rate which becomes its clock. It “sees” this through the PLCs interacting with it.
- Time, therefore, a measure of causal interactions, only applies to those interacting entities: PLCs- like Photons and matter, and not to the PLs of the Mesh. It is observer dependent, with a PLC clicking from node to

another not observing time in its frame, while a PLC clicking in place observes the changes in the surrounding mesh.

- For the individual PLs that form the space-mesh, their multiple connectivity allows a “faster” speed, making the mesh a superluminal network with a simultaneity defining a preferred frame, against which the space-time for PLCs plays. One then has two concepts: an absolute time for the mesh (which has a flexible 3D space structure) of PLs, and a Lorentzian emergent space-time for the PLC events.
- We therefore define a new concept, the Speed of “Space-Time”, which is the true invariant “ c ”, also the Speed of Light. It is the speed of events, events being defined as a “change” for a PLC cluster (radiation, or matter), being the result of the clicking in the Mesh. Motion in Space negates motion in time, and motion in time implies stationarity in Space of the event. The “Event” concept changes the view from a 3D Space + time for PLs to a 4D Space-Time view for PLCs. The “Vacuum” thus has an absolute time & simultaneity, whereas the emanent matter/radiation view exhibits a Lorentzian spacetime.
- The Speed of light for the moving particle (or any particle in its own frame) is the c constant speed of light (Photons/PL clusters which we see, compared to the puny PL we cannot see), regardless of frame of reference, BECAUSE time is DEFINED (& perceived & measured) as the clicking of the Photons through the mesh, and distance is DEFINED (& Perceived) as the number of mesh nodes crossed by the light, which remains constant from any point of view. Hence the equivalence of space and time (with a factor of c). Gerard ‘t Hooft says “time is the order by which you solve the equations”, and space “how many equations are they away from each other”. It is the “book-keeper” of causality and time’s arrow.
- With a fixed light-speed in all reference frames, Special Relativity and Minkowski space-time come out naturally. (The slower speed of light in matter versus vacuum is a reflection of light’s travails in its travels, absorption and emissions & scattering in matter causing a “stopping” effect along the way, the lazy light of Kalam. An extreme case in Bose-Einstein condensates can “stop” light completely, through continuous absorption and emission, matter effectively “juggling” light – Alternatively, light could be visualized as “swinging” to avoid the higher density of matter in its path- the rfraction view of Eddington. Anpther

view is light following the warped geodesic of the PL spacemesh – all equivalent scenarios as we shall see).

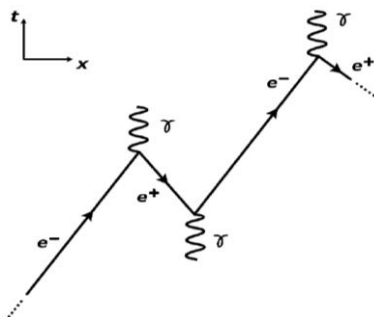
- An alternative approach to Relativity is Lorentz & Fitzgerald's, where "compression" of matter causes the relativistic effects. This approach is very close to Einstein's, simulating the same effects as Special Relativity, and the "Light World" hypothesis can provide a mechanism for the "contraction" assumed, with rotating matter getting out of step as it moves in the Ether and deforming to catch up... A mathematical analysis shows both approaches to be equivalent. Einstein himself was ambivalent, commenting on relativistic effects on mass : "A general answer is not yet possible because we do not have a complete world-view that would correspond to the principle of relativity". We propose a different explanation based on the definition of time and motion for an "event".
- Time and distance are therefore just two apparently different aspects of the same thing. If we attempt to achieve the speed of light, our clocks will slow relative to our stationary point of origin and we will seem to arrive at our destination quicker than we anticipate that we should – as though both the travel time and the distance have contracted. Similarly, as we approach the surface of a massive object, with a higher density of PLs to cross, our clocks will slow relative to a point of higher altitude – and we will arrive at the surface sooner than we might anticipate.



- One effect of Relativity: Time does not fly when having fun – it actually slows down when you are moving!
- The effects of Special Relativity "contrive" to make the speed of Light appear to be constant, with rod lengths and clock rhythms changing depending on your perspective. The Lorentz transformations serve to

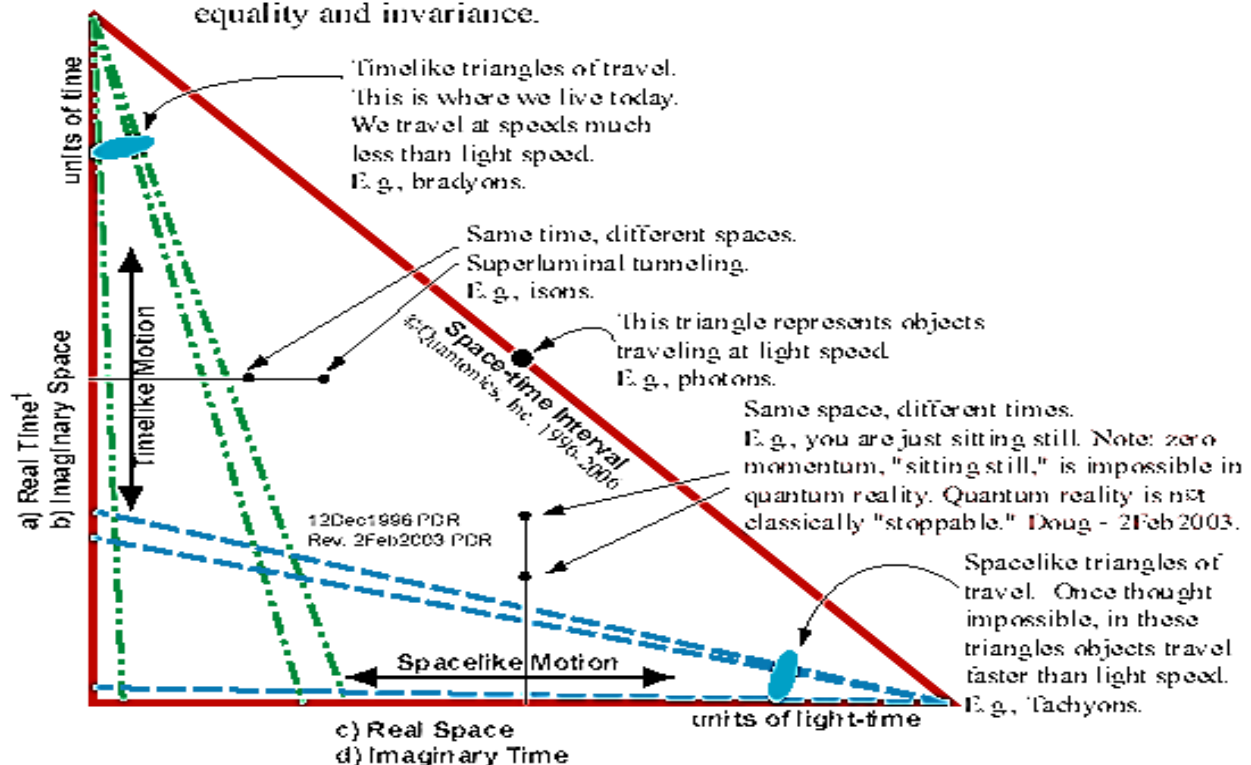
describe those (equally apparent) changes in the Rods and Clocks. Instead of Lorentz and Fitzgerald's "Ether Pressure" doing the compression and changing, we propose that the effect comes out of a "fixed speed of events" in Spacetime, where the motion in Space of an event is not perceived as time, resulting in the fixed "Space-time" interval speed of " c ". This view marries Einstein's and Lorentz's views, and reconciles them with the Ether. With this definition of "Spacetime" speed, we can have our own "proper" time, and they can have their slower "relative" time, while still remaining in the "absolute" Space-Time.

- "It would probably be prudent to mention: All processes—chemical, biological, measuring apparatus functioning, human perception involving the eye and brain, the communication of force—everything, is constrained by the speed of light. There is a clock functioning at every level, dependent on light speed and the inherent delay at even the atomic level." Biological aging is equated to clock time-keeping by John A. Wheeler in *Spacetime Physics*.
- Wheeler (and Feynman) thought, though, that much of Electrodynamics could be explained by "Advanced" as well as "Retarded" action of waves, implying a time reversed effect of waves (the future affecting the past!). The equations worked (they are part of Maxwell's fundamentals, even though rarely used because of their non-intuitive concept). This backward travel in time may just be a simple mathematical artifact that works (Feynman wondered about how many different ways you can approach a problem and resolve it, all making sense), or it may be another sign that our intuition may not be the best of guides (as relativity and QM have shown). Ultimately, this led Feynman to his "Sum-over-Histories approach and QED, both well proven theories (perhaps confirming his thesis that there are many ways to skin a solution).



- If you travel at the speed of light, then theoretically you would not age! What that also means is that nothing happens for you... a very boring existence- you would be “frozen” in time, alive but not living, a Sci-Fi scenario gone awry.
- In 3D space, the equation: $ds^2 = -c^2 dt^2 + dx^2 + dy^2 + dz^2$ would hold; Where ds is the “separation” or “space-time interval” between two nodes. Traveling in space is essentially then the same as travelling in time, and the 4 dimensional space-time concept is emergent. Time dilation and Lorenz contraction would also emerge out of this scenario.

Minkowski invented this spacetime triangle to graphically illustrate Einstein's space-time invariance. Einstein unified space and time for his theory of relativity, so Minkowski forced them to graphical equality and invariance.



- In a logical world, there are only “events”. In Hilbert Space, the events click forward. Those events can be classified (interpreted by our Mind as it tries to make sense of the Fun-House it is in) as one of two ways:
 - o An event of moving in space
 - o An event of staying in place, while the world moves a step forward in time – an event in Time. In effect, a time event is a no-space-event, reflecting no “change”. (“Passing time” when idling ☺). While an external clock ticks (in other matter/space), if a

particular object does not “change” or move, then that non-event for it is an event in time. This is a construct of our minds, reflected in the construction of space-time.

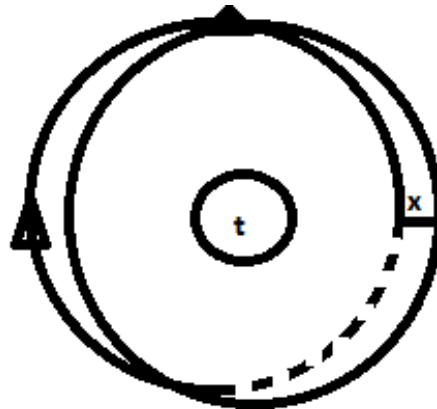
The rate of events is the constant, the speed of Light. If an event is a space event, then time does not click. If no space event takes place, time clicks forward. An interval is **the time separating two events, or the distance between two objects, or a combination of both.**

$$(\text{SpaceTime Interval})^2 = (\Delta t)^2 - (\Delta x)^2 ; s^2 = x^2 + y^2 + z^2 - (ct)^2$$

Lorentz & Minkowski take over from there.



- This business of why moving in space is equivalent to moving in time needs a picture. Here it is:



Moving in Space and Time

Our natural conception of Time is essentially a clock mechanism, calculated/seen from physical processes. It is essentially driven by cycles of matter, including electron orbits around nuclei in our brain, etc. In our PL picture, the electron itself is a photon loop, and its cycle around the circumference ticks time for it. A stationary electron cycles one unit of time every time it goes around the circumference. In fact, it defines its own time this way.

Now see the electron moving in space. If it has to move a distance x , then somewhere the loop has to shift that distance. For simplicity's sake,

let us assume it makes that in one shift. Since the photon is going at the fixed speed of light, when it is shifting the distance x , it is not completing its cycle – it is not marking time! An effective “loss” of x/c of time is “wasted” moving, slowing down the photon from completing its round. The electron now clicks slower compared to a stationary electron– time slows down. Taking the extreme case where the particle tries to move at the speed of light “ c ”, it has no “time” to complete its cycle – it always moving in space, and never register a single click! In fact it is not rotating anymore – it is a free photon again!

That is why the “combined velocity” in space and time is “ c ”. What you use in space (moving x), you lose in time (cycling t). If a PLC clicks in the same node, we call it a “time move”; if it clicks into another node, we call it a “space move”. It is a simplified picture if you need one. Lorenz derived it the hard way, from Maxwell’s equations of a moving charge. Einstein used the fixed speed postulate and derived the rest from Geometry and kinetics (with a little help from Minkowski). John Bell saw the connection and both sides of the coin. That is why I admire Lorenz, am in awe of Einstein, but I like John Bell.

BTW, the trick applies for ponderous material and energy, which has something to “click” or cycle. It is an emergent feature of our microworld. But at the planck scale, at the PL level, it does not apply. In their motion, they sense no time. Hence they can go at any speed in the 3D mesh – exhibiting entanglement effect, carrying pilot waves, and non-local aspects. The speed limit of “ c ” applies only to PLCs, the clusters of radiation and matter – and us.

- Another interesting way of looking at the equivalence of time and space: consider two points, A & B, a distance d apart. For an event to take place between A & B, from A’s point of view, one of two things must happen:
 - B moves to position A, covering distance d , while A waits in place a time d/v .
 - A moves to position B, covering distance d , while B waits in place for a time d/v .

The event AB, from A’s point of view, is either a wait in time, or a motion of distance d . Our construction of spacetime, using the ubiquitous speed of light, reflects that event structure.

- An interesting question: If time is defined as rate of interaction, and the variation of physical quantities is time, then how do we perceive time at the initial Big-Bang Singularity? A few thoughts:
 - When only a single node is building up, the beginning of creation, no interaction is taking place, the PLs being accumulated but not interacting between nodes (that yet have to exist). No Time is defined – Time does not exist yet.
 - When the Singularity starts to spread, one can take two points of view: (1) If each “click” of the matrix is a measure of time, then the expansion is proceeding very fast in “space” (while creating “space”), hence the period of Inflation where we can say the Perfect Fluid (Plasma/Radiation) is moving faster than the speed of light in those first few 10^{-35} seconds. (2) One can stick with the Speed limit definition for the motion of radiation, and think of time passing very fast (?? Huh??). OK, I’ll rephrase this: we redefine time as the interval where “c” units of space are created. In the Inflation period, then, we still expand at the speed of light, and take a long time instead- those 10^{-35} seconds are then redefined to be in billions of years. In fact, one way of defining time (conformal time, $=\arctan(t)$ in an Einstein Universe) would translate the 15B years of “proper time” to an infinity since the big Bang, and resolve the “what was there before” question, since no such “time” existed (outside of time). The Singularity itself is not in Time, and “proper Time” may not be the best measure of passage of physical Time near the Singularity. Misner (and Milne before him) substituted $\log t$ for t , and found the singularity then disappears into the infinite past – “The universe is meaningfully infinitely old because infinitely many things have happened since the beginning”. Joao Magueijo’s VSL approach where the speed of light is much higher at creation is another way of looking at the same phenomena.
 - The concept of Space-Time still emerging at that epoch, the rules of relativity would not apply in that period. Time is then defined as the rate new “space” is being created, equivalent to new “information” creation (Tipler).

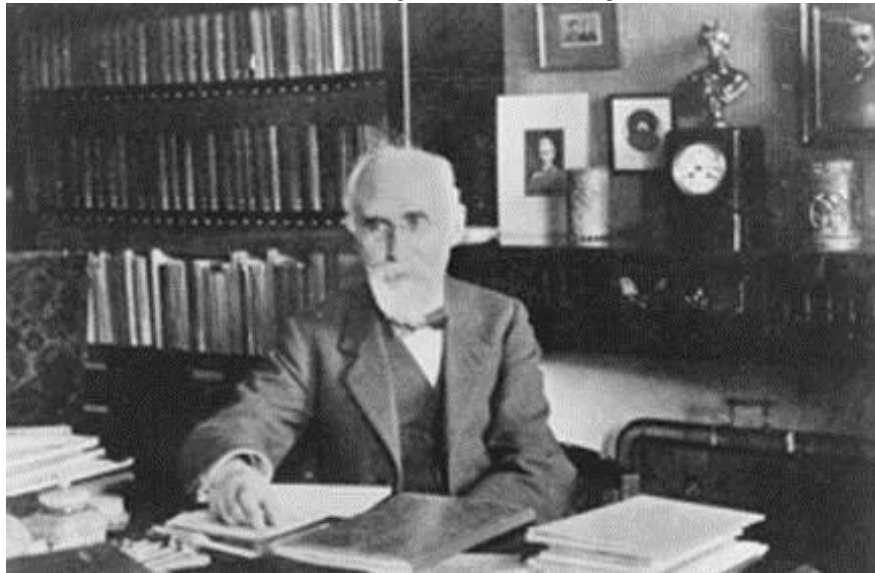
“Was it a God who wrote these signs, That have calmed the yearnings of my soul, and opened to me the secret of Nature?”

–Boltzmann, on Maxwell’s Equations

“While it is commonly believed that there is something called time that is measured by clocks, one of the great lessons of relativity is that the concept of time is nothing more than a convenient, though potentially treacherous, device for summarizing compactly all the relationships holding between different clocks.” – Mermin

“Our Manner of conceiving the fourth dimension, therefore, is as space changing in time. We are to think of the physical universe accessible to our observation as possessing at least four co-ordinate and interchangeable dimensions, of which three are included under the name of space, and the fourth is called time. If all movement in space were suddenly to cease, the fourth dimension would be eliminated from it. Fantastic as this idea may appear, it is exactly that which has produced interesting results in dealing with the problem presented by the ether of space. Mathematical Physicists have found that apparent experimental contradictions disappear and the mathematical framework of physics is greatly simplified if, instead of referring phenomena to a set of three space axes and one time axis of reference, they are referred to a set of four interchangeable axes involving four homogeneous co-ordinates, three of space and one of time. Time, in other words, is employed as though it were a dimension of space – the fourth dimension”. - Claude Fayette Bragdon - 1913

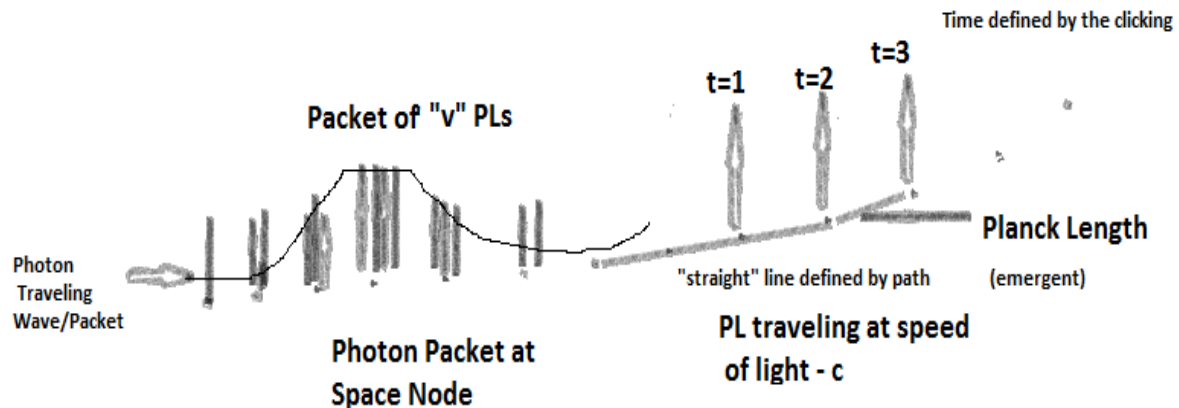
“When you’re idling, you’re just “passing time” quickly. And Time slows down when you’re having fun. If you want to look thinner, start running.”
- Sam’s theory of relativity ☺



Lorentz

Takeaway: Time is the clicking action of the PLs in the mesh. As PLs click in/out of existence, they can either move in ‘space’ (between nodes) or in ‘time’ (at the same node). Special Relativity is thus derived.

3.5 - MOTION AND PROPAGATION

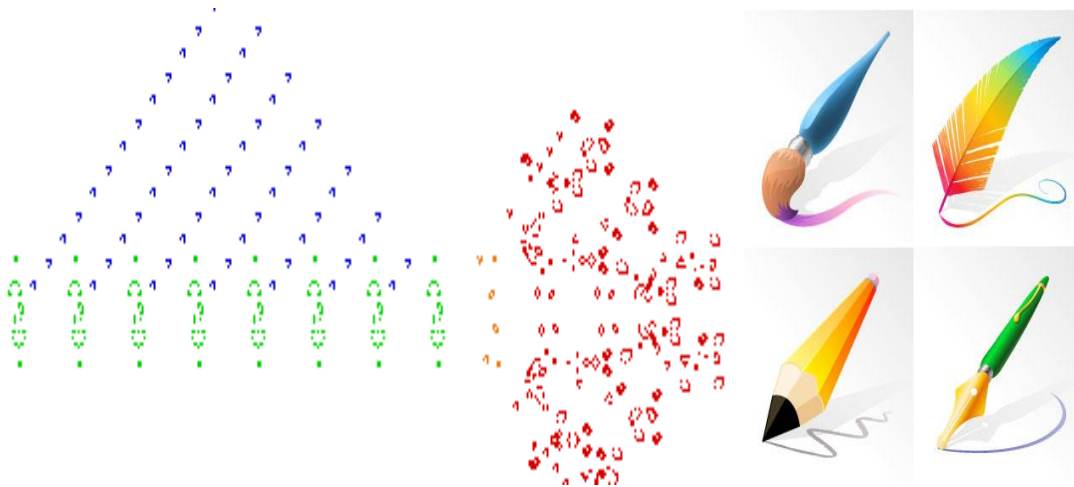


PL Motion At Speed "c" & Frequency "v"

- "Traveling" for the PL means a click in the fabric of space (which it represents), which is linked (a-la- Loop Quantum Gravity) in minimal increments of **Planck length** (so defined post-facto, as the smallest step- denoted ℓ_P , equal to $1.616199(97) \times 10^{-35}$ metres). A PL clicks along at a particular rate (Also defined (perceived) post-facto once time is defined by it), resulting in a "speed". In fact, this is our convention of measuring time, by counting clicks. "Time" is an emergent feature of this clicking, defined by it, rather than "timing" it. The meter is now defined by the speed of light, in wavelengths of the Cesium clock wave that "measures" it.
- Photons are gregarious PLs, travelling in packets, bundled in packets of PL "particles" (their numbers corresponding to the frequency in appropriate units; frequency having a maximum limit imposed by the speed of light and the planck length). As those particles roll along, their configuration moves along as well, in a wave-like formation, with an "energy" of $h\nu$.
- The PL itself can be seen as the actual "clicking" into existence of space itself, or a "jump" between the nodes of the Loop. Think of those ripples as the actual PLs, moving along, hopping the nodes or creating the nodes as they go, drawing the world as it moves along, a basic "Game of Life" in progress. Boscovich, who thought each and every particle of the Universe is dynamically related to every other particle, large systems of

cohering material points interpreted as a “little solid mass”, would approve.

- The PLCs are a reminder of the “Vortices” of space of late Nineteenth Century science, espoused by Kelvin and Helmholtz, an idea as old as Anaxagoras (500BC). Tait’s demonstrations of smoke rings stability, bouncing, and coherence convinced them such clusters of ethereal fluid could be the basis of matter. Their modes of vibration observed a shade of modern string theory’s vibrating strings. Those “eddies” in the perfect liquid could remain in stable states immune from dissipation. Complicated atomic structures could be built by a variety of “knots” (starting an interest in Knot theory still active today). The principle was simple and visualizable, even though the mathematics of such vortices (as all turbulent fluid flow mathematics) is immensely complicated, certainly beyond the capabilities of the time.



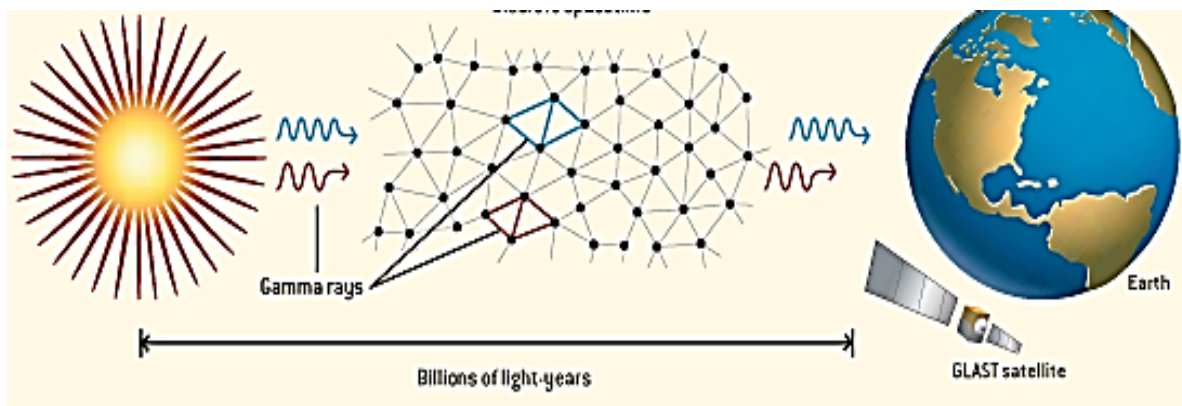
- To quote Clifford:
“I hold in fact
(1) *That small portions of space are in fact of a nature analogous to little hills on a surface which is on the average flat; namely that the ordinary laws of geometry are not valid in them.*
(2) *That this property of being curved or distorted is continuously being passed on from one portion of space to another after the manner of a wave.*
(3) *That this variation of the curvature of space is what happens in that phenomenon which we call the motion of matter whether ponderable or ethereal.*

(4) That in the physical world nothing else takes place but this variation, subject (possibly) to the law of continuity.

We may conceive our space to have everywhere a nearly uniform curvature, but that slight variations of the curvature may occur from point to point, and themselves vary with the time. These variations of the curvature with the time may produce effects which we not un-naturally attribute to physical causes independent of the geometry of our space. We might even go as far as to assign to this variation of the curvature of space “what really happens in that phenomenon which we term the motion of matter.””

Why Clifford is not given joint partial credit for General relativity, I don't know. Unless he is accused of “anticipatory plagiarism”, in the words of Robert Merton, as “when someone steals your original idea and publishes it one hundred years before you are born.” ☺ Particles, the building blocks of Matter, and EM Waves, are both disturbances of the Space “Field”, of Space itself – “Space moves, and everything is made of that”, says a favorite blogger.

The Photon, or all matter motion, being the moving ripple of space, the space formed by the PLs. Substance is an emanation of space, our perception of the ripples in the fabric.



In loop quantum gravity, a photon occupies a (large) number of edges at each instant as it moves through the spin network that is space. Owing to the granularity of space, photons of different colours – in this case emitted by a very distant gamma-ray burst – may travel at slightly different speeds, resulting in a potentially measurable difference in arrival time at the Earth. The GLAST (Gamma-ray Large Area Space Telescope) satellite, launched in June 2008, is expected to have the sensitivity required for this experiment.

From Atoms of Space Time, Lee Smolin. Copyright © January 2004 by Scientific American, Inc. All rights

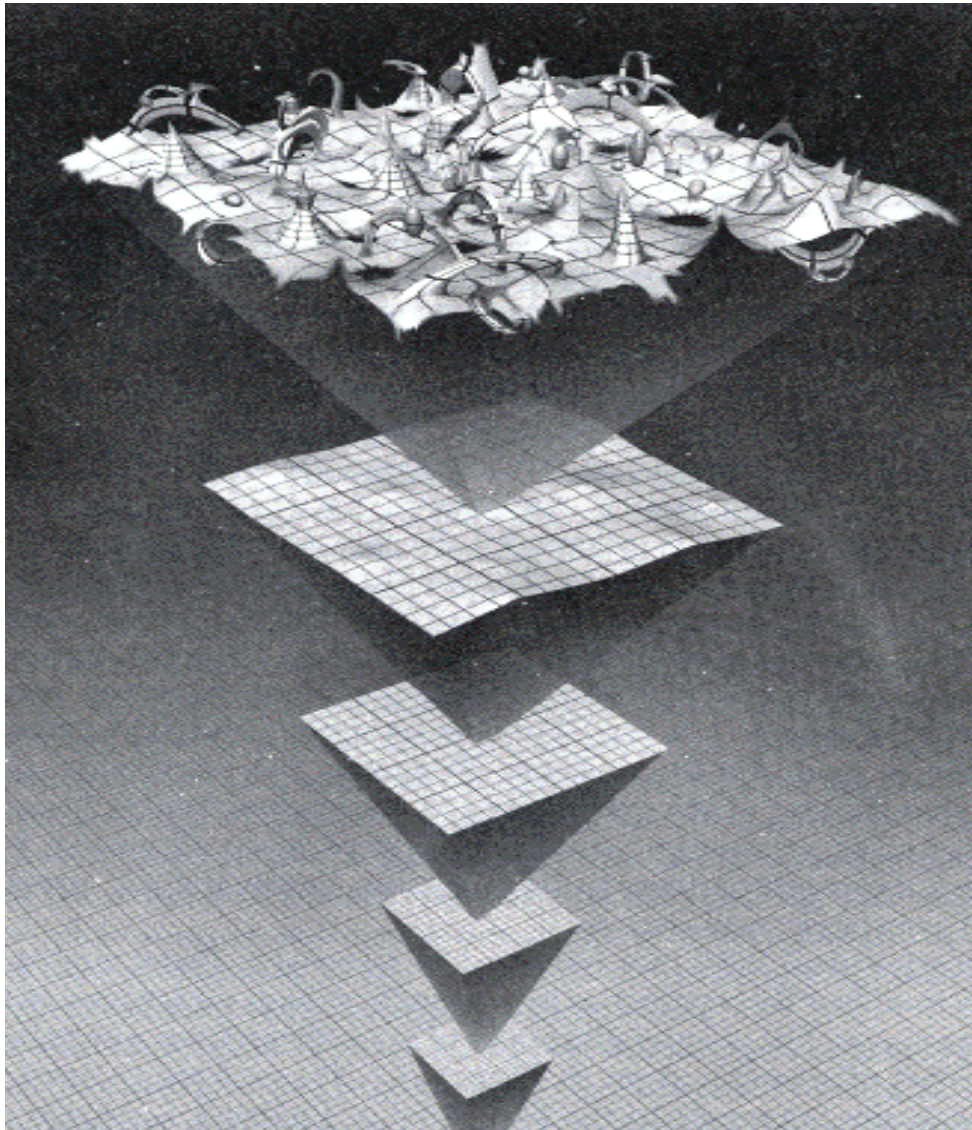
- Straight Lines: so how do we get shapes and forms out of a Hilbert space of existence? We make it up! Our vision and understanding of the world,

involving interactions in that space, DEFINE a straight line as the “path” (read clicking sequence) of the Photons in the virtual space, since the photon is what we “see”. (One theory: our emotional reaction to an approaching object, where time to arrival seems shortest by the light path, drives this definition). Since the Photon can be seen clicking (and defining) neighboring nodes, its path is, by default, the shortest distance from “there” to “here”. Light sweeps out the Geometry of Space as it moves. Even when the geometry of “space” itself is curved, we still “see” the Light (which moves along this curve) as a straight line, having defined it as such. For us, Photons relate the old Maxim: “Traveler, there are no paths, paths are made by walking.”

- The “Speed of Light”, c , is the “distance traveled” (read number of nodes jumped) by the photons/PLCs per unit time (read also number of jumps), and hence is essentially unity – which means it is self defined. It is the standard against which we define time and distance, the scaling factors being arbitrary.
- The “Distance” between nodes would be a virtual distance in existence space, but we cumulate it to reflect emergent perceived distance in space. The Planck length would then be the “distance” between two successive nodes.
- The Planck time would be the “time” between clicks – only becoming meaningful when the interactions between nodes are detectable (as for PLCs and not individual PLs) and require causal numbering.
- At very small “distances”, with individual PLs forming and disappearing, and no clear “relations” established, the space would look like a “space-time” foam of vague aspect, churning continuously. Its uniform aspect would only appear at larger scales, with large interacting clusters like Light Photons creating the time causality dependence, and the ordered structure of space.
- In the Beginning, at the Big Bang, one can conceive a planck size “space” node, not real space since it has no relations; and with no degrees of freedom – since the PLs at the node do not click in space to form time – hence no time. The Beginning really starts with the first expansion, where new nodes create space, possibly in the 10 dimensions, and the node becomes a “foam”. Those foams would look like miniature Black holes, coming in and out of existence. Time and Space are still “fuzzy”,

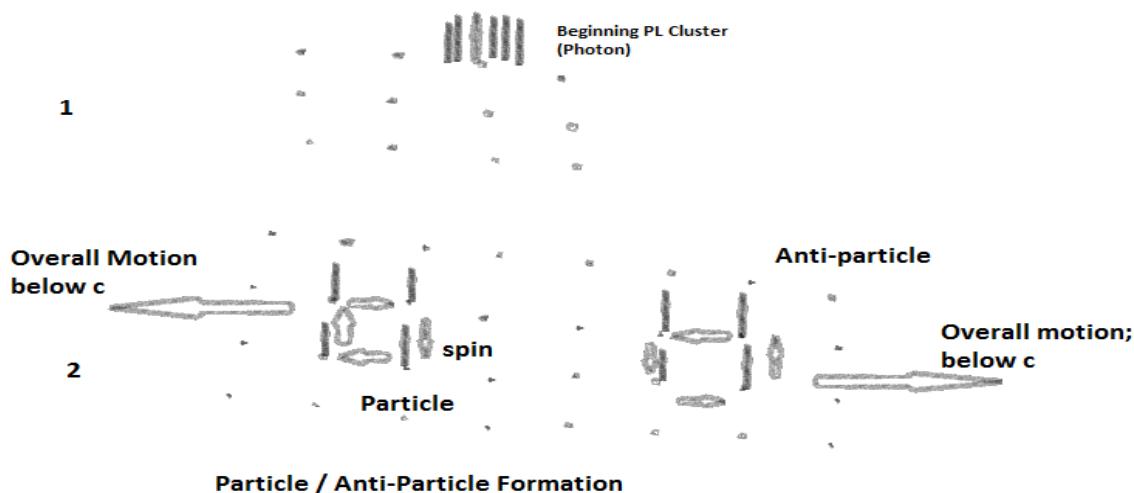
until significant expansion and interactions start to smoothe and define them.

“In modern physics, one has now divided the world not into different groups of objects but into different groups of connections ... What canbe distinguished is the kind of connection which is primarily important in a certain phenomenon ... The world thus appears as a complicated tissue of events, in which connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole.” - Heisenberg



Takeaway: The moving PLs and PLCs paint the world in their motion, as they oscillate into existence. PLCs (Photons) define straight lines. Kinks in the fabric represent matter and energy.

3.6 - MATTER, MASS & ENERGY



When a bundle/cluster of PLs (PLC) is big enough, it can “break-out” into one of two stable configurations, an Electron and a Positron, or a particle/anti-particle. The PLs split into two equal lots (with possible leftovers – more below), their “forward motion” (let us call it **“light” formation**) becoming spin motions (let us call it **“matter” formation**) in the space matrix. For Electrons & Positrons, somehow, the “breaking out” into those two configurations is symmetric, but with “flipped” charge “directions”, with one “creating” a Charge property, the other the opposite charge. When that happens, the neutral PL packet is not neutral anymore, but is in two halves of “opposite” charge – matter and anti-matter – Gauge Symmetry in action.

The forward “clicking” of the electron would measure our time, the positron “clicking” backwards seeming to travel back in time, as Wheeler thought. This idea led Wheeler to believe the whole Universe had only one electron, running back and forth in time “painting” the world (our slice of time showing its many back and forth journeys as independent electrons and positrons), another CRT analogy to contemplate (are we a computer simulation of some higher beings?). Feynman used this “backward” travel in time in constructing his ideas for QED (backward travel, as well as faster than light, is part of QED).

Mass is energy and energy is mass, as Einstein’s immortal $E=mc^2$ reminds us, “mass-energy” taking on different aspects depending on how we view it. We do not convert mass into Energy – we convert rest mass-energy into kinetic energy. Okun’s masterful summary is a must read.

If the gravitational mass of a photon (created, say, by annihilating an electron of rest mass m) is $mg=E/c^2$, but its rest mass is zero – then what happened

to the rest mass? Bad question for a photon that never rests, but a good physics question. The question is, as van der Mark and 't Hooft ask in “Light is Heavy”, “What is rest mass”?

They see that “What is intriguing is that matter’s most basic building blocks, the elementary particles, all have non-zero spin, intrinsic angular momentum, which seems to imply that they all must have some sort of intrinsic dynamics. Hypothetical structures which do not have internal dynamics, such as point particles and hard spheres, do not exist. So what is matter really made of then? In Dirac theory, the electron is like electromagnetic energy quivering at light speed, just like a photon in a box. If really so, matter is light”. And if Light has zero rest mass, why doesn’t the electron? Their answer:

- “Rest mass never applies to a system at complete rest, because such systems do not exist; there will *always* be internal dynamics”.
- “Rest mass applies to the center of mass of a closed system”.
- “The gravitational mass is equivalent to the total energy of an object or system”.
- “One could say: “Matter is just “canned” energy, a box with internal dynamics, and radiation is “free” energy””.
- “If the photon would be put to rest, its gravitational mass would equal its rest mass, and hence vanish. The intriguing question is, what would happen if we could stop the electron from spinning?” Luckily for us, photons don’t rest, and electrons always spin, because their photon component will always rotate.

To “weigh” a photon we have to get it in a box to fix its “average” center of mass (say by using a box of mirrors). When we do, we actually measure a “rest mass” equal to the “gravitational” mass. This is exactly what happens in “Matter”, which acts like an “energy container”. When we annihilate a particle, we are basically opening up the container, to let the photon loose. “Photons contained have mass” – an electron being just that. “In the future the mass of an electron will be derived from a computer simulation based on its photon structure”. The flow of energy going around the electron, that circulating Poynting vector $S = E \text{ (Electric field)} \times H \text{ (Magnetic field)}$, is a rotating photon.

As B. Kivel proposes in his “Photon theory of the electron”, a relativistically invariant electromagnetic field model of the electron provides the self-field needed to distort space-time so that “the photon geodesic in the rest frame has

a radius of curvature of the order of the classical electron radius". A similar proposal by U. Enz provides a new type of soliton with particle properties, a stable classical field structure model with quantized properties, creating a string-like structure that can be identified with the electron and the positron in the simplest cases, with the total energy of the field structures equated to the rest energy of the particles. The configurations follow from a simple least action principle based on energy density.

Barut and Grant constructed localized three-dimensional solutions of the free Maxwell equations that simulate relativistic particles, simultaneously modeling the wave-particle duality of quantum particles. Oscillating configurations of electric and magnetic fields whose centers move like a relativistic particle with a velocity $v < c$ and do not spread acquire an effective mass determined by the frequency of oscillations in the rest frame of the lump. "The idea of constructing localized solutions of Maxwell's equations goes back to Bateman and Japolsky".



Nature occasionally throws us a hint on this, with its Ball Lightning an analog of our tiny electron. Kapitsa described the ball as serving as a resonant microwave cavity, automatically adjusting its radius to the wavelength of the microwave radiation so that resonance is maintained, as the EM wave circulates among the cloud ions. Julio Rubenstein, David Finkelstein, and James R. Powell saw it as St Elmo's Fire, a soliton in the flow of atmospheric

electricity. Closer to our idea, Domokos Tar suggested that Lightning strikes perpendicular to the ground, and thunder follows immediately at supersonic speed in the form of shock waves that form an invisible aerodynamic turbulence ring horizontal to the ground. Around the ring, over and under pressure systems rotate the vortex around a circular axis in the cross section of the torus. At the same time, the ring expands concentrically parallel to the ground at low speed. Seward proposed ball lightning is a spinning plasma toroid or ring, and Chen found that there is a class of plasma toroids that remain stable with or without an external magnetic containment. Manykin et al. suggested atmospheric Rydberg matter as an explanation of ball lightning phenomena- a condensed form of highly excited atoms in many aspects similar to electron-hole droplets in semiconductors. Closer to home: V.P. Torchigin proposed (2003) considering ball lightning as a form of self-confined intense light. M.I. Zelikin proposed (2006) an explanation (with a rigorous mathematical foundation) based on the hypothesis of plasma superconductivity.

The idea of an electromagnetic electron mass goes farther back, to J.J. Thomson who discovered the particle, to Wilhelm Wien, Max Abraham and Lorenz who pursued the idea, Poincare (who thought electrons are “concavities” in the ether, like all matter), and to Feynman, Leighton and Sands, Fritz Rohrlich, Bucherer & Langevin, among others. Feynman points out that electromagnetic mass accounted for most of the mass, but not all – Poincare Stresses accounted for the rest. But he indicates that we don’t know what those “rest” are – he conjectured oscillations in those stresses could be the muon! Hasenhorl also thought part of the mass can be thought of as radiation bouncing around a cavity. Clearly, what was needed was a new approach, to unify the theory and fulfill the math. It would be “unnatural” for nature to have “most” of the mass (in fact a rational fraction) electromagnetic, and not show us what the rest is. A rotating photon picture seems to do the job. We propose this is the right idea, both intuitive and beautiful – Dirac’s criteria met.

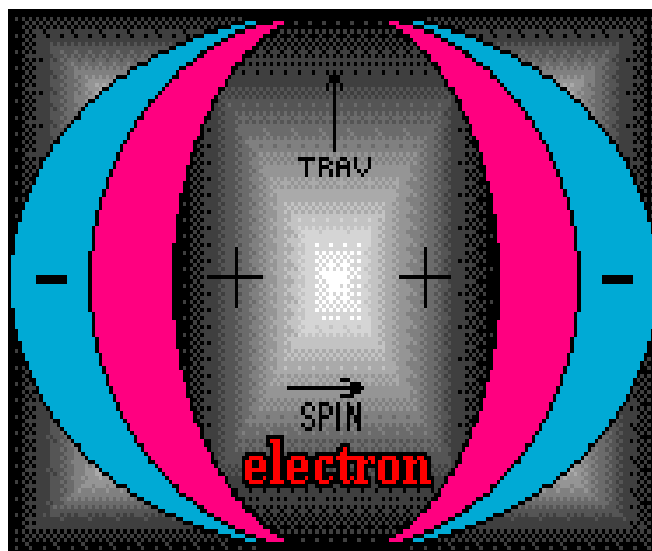
“It is important to realize that in physics today, we have no knowledge of what energy is. We do not have a picture that energy comes in little blobs of a definite amount. It is not that way. However, there are formulas for calculating some numerical quantity, and we add it all together it gives “28” – always the same number. It is an abstract thing in that it does not tell us the mechanism or the reasons for the various formulas.”

- Feynman

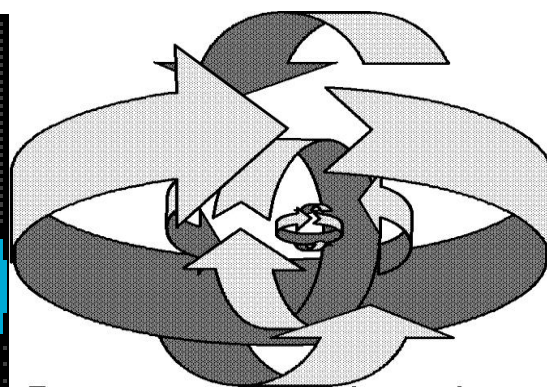
3.6.1 A MATTER OF PHOTONS

We therefore propose all matter is constituted by Electromagnetic waves. We propose the electron as a looped photon, a rotating photon loop presenting itself as matter – “a closed path of curved space that can only be opened by a positron”. A Photon somehow creates a non-linear deformation of space-time that leads to a circular geodesic. Note the parallel to String Theory’s open string (photon) and closed string (fermions). This idea has been entertained by many, and has proven itself a viable model, providing a match with particle properties. We also propose quarks and other forms of matter as similar “color photon” loops, those color photons being in other dimensions than the typical EM photon dimension.

One team’s (Brown, Thompson, Photonic World) vision of this “trapped” light for an Electron and a proton:



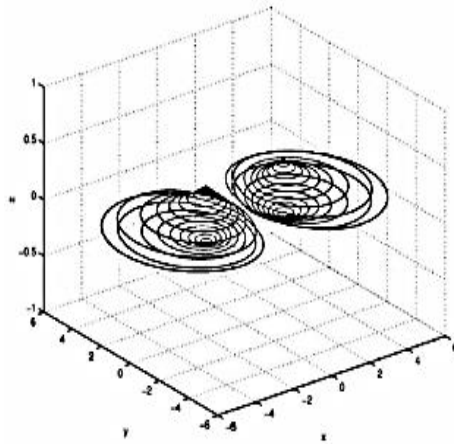
Electron as trapped resonance



Proton structure is three photon shells. Each spin in the primary direction at the speed of light and in a composite flatwise secondary direction resonant with the next shell out.

Obviously other “locked UP” Photon theories are possible, and other configurations have been proposed (Williamson & van de Mark; Miles Mathis; Erik Andrulis, B. Kivel, U. Enz, Barut & Grant, etc.) and need to be studied, but the principle is pretty clear. The electric charge arises from the electric field of the confined photon circulating in its own warped (by EM field curving space-time) space. Recent experiments show photons trapped in resonant cavities exhibit electric charge like an electron. As one of my favorite bloggers says: “Each fermion is like a photon in a box of its own making”. When matter and anti-matter meet, “you open each box with the other. Then each photon

departs at c from a “standing” start, and there’s no boxes left” (John Duffield). The photon “packeted symmetry causing no “resting warp” in spacetime”, while “the electron causes a unidirectional “warp” in spacetime”. Eddington’s electron “wavicle” is more than duality- it is an actuality.



Such spinning photons would give a “real” meaning to the Electron spin, something our “point particle” picture of the Electron did not provide when Uhlenbeck and Goudsmit first conceived it. (Furthermore, Pauli’s analysis in QM sees spin as just the polarization-dependent part of the wave field’s angular momentum, suggesting our EM picture above). So the “Solar System” analogy of the electron around the nucleus is complete- the electron is a miniature earth, rotating around the Nucleus (Sun) and also spinning about its axis. Nature repeating her successful tricks again. The roughly linear relationship between the square of particle mass and their spin should come out of this scenario. It also explains the “intrinsic” magnetic moment (such as the electron magnetic dipole moment), related to quantum-mechanical spin.

As Ohanian (building on earlier work by Belifante) has shown, “spin may be regarded as an angular momentum generated by a circulating flow of energy in the wave field of the electron. Likewise, the magnetic moment may be regarded as generated by a circulating flow of charge in the wavefield. This provides an intuitively appealing picture and establishes that neither the spin nor the magnetic moment are “internal”, but associated with the structure of its wave field. “Furthermore, a comparison between calculations of angular momentum in the Dirac and electromagnetic fields shows that the spin of the electron is entirely analogous to the angular momentum carried by a classical circulating polarized wave.” It walks like a duck, quacks like a duck, Goudsmit and Uhlenbeck had a mechanical picture of the electron as a small

rigid body rotating about its axis, also considered by Kronig but discarded on the advice of Pauli, Kramers, and Heisenberg who (you guessed it) didn't like picturing actual electrons – I rest my case! In the electron, as in the Photon, the spin is part of the electromagnetic wave's angular momentum – clearly so since the electron is a spinning photon.

This implies the wavefields have states of polarization, unlike QM's scalar wavefunctions (modeled as spinors). However, this is just a mathematical tool for understanding spin as misinterpreted (not pictured) in orthodox QM, and both vector waves and scalar waves can be used to model this for the electron. The fact that Electrons are fermions, obeying the Exclusion Principle, can then be easily explained and pictured. The repulsion between the two electrons is enforced by the "Bohmian" quantum "Fifth Force" resulting from the electron wavefunction, which produces forces of repulsion between them due to the "antisymmetry" of fermions, bringing correlations to their motion. Since Anti-Symmetrical wavefields have node surfaces, as opposed to the symmetrical ones of Bosons, the quantum force is always directed away from these nodes, causing the repulsion, which grows to a very large strength as they get closer, providing the "electron pressure" that holds white dwarf stars from collapsing. Alternatively, you can simply consider the negative charges repelling more as they get closer (Coulomb Force). The math works either way. Interestingly, Ehrenfest had "proved that the center of gravity of the [electron] wave packet moves according to the classical law: $\text{force} = \text{acceleration} \times \text{mass}$, provided the force exerted upon the electron by the electromagnetic field is calculated by integrating the Lorentz force over the charge density $-e\Psi^*\Psi$ ". (B.L. van der Waerden). "we pretended that the Schroedinger wave packets were no more than a superficial analogy of the mixed states of Dirac. It was Bohr, primarily, who revealed that they are far more than an analogy. They are, in fact, and exact counterpart, but expressed in the language of waves rather than in that of particles. From them one may readily extract the indeterminacy relation of momentum and position, or of energy and time" (Hoffmann).

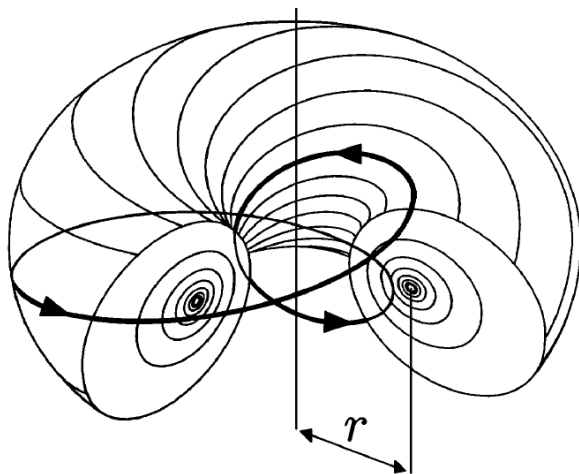
Feynman, in his QED musings (summarized in his 1965 Nobel Lecture), thought that the main effect of Electron self-action would be the effective modification of mass – that effectively all the mechanical mass could be electromagnetic self-action. Look at it another way: the kinetic energy of a moving particle is $\frac{1}{2}mv^2$, and the energy of mass is mc^2 . Is it because

that is the “kinetic energy” of rest mass, which is not actually resting but circulating at the speed of light c ? The factor of 2 comes out of kinematic/potential energy relativistic considerations (a doubling effect commonly seen; related to the Virial theorem, Spin effects (Boson vs Fermion), but the hint is pretty clear). Wheeler’s “Momenenergy” calculations can help. A similar factor of 2 in the gyromagnetic ratio of the electron had confounded the early QM leaders until explained by Thomas with a general relativistic calculation of the orbital motion.

Montonen and Olive, generalizing results from the discovery of ‘tHooft-Polyakov monopoles in gauge theory, found that electron masses obeyed the following mass formula: $M^2 \geq c^2 (q_e^2 + q_m^2)^{1/2}$.

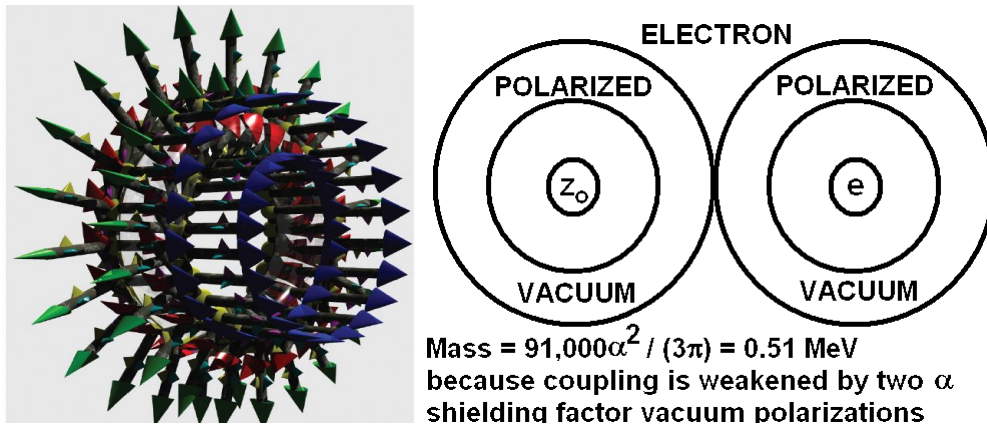
Where q_e and q_m are the electric charges and magnetic charges, respectively, and c is a constant. For BPS states, this becomes an exact equality. In other words, Mass is a function of charge... not surprising for us, who see both as an EM effect.

Schroedinger had thought particles as wave-packets which remain localized in a small region of space. He even showed that these waves remain small and do not spread in space for many cases. Interestingly, his equations describe an evolution as a **rotation** of the state vector in the **system Hilbert space**.



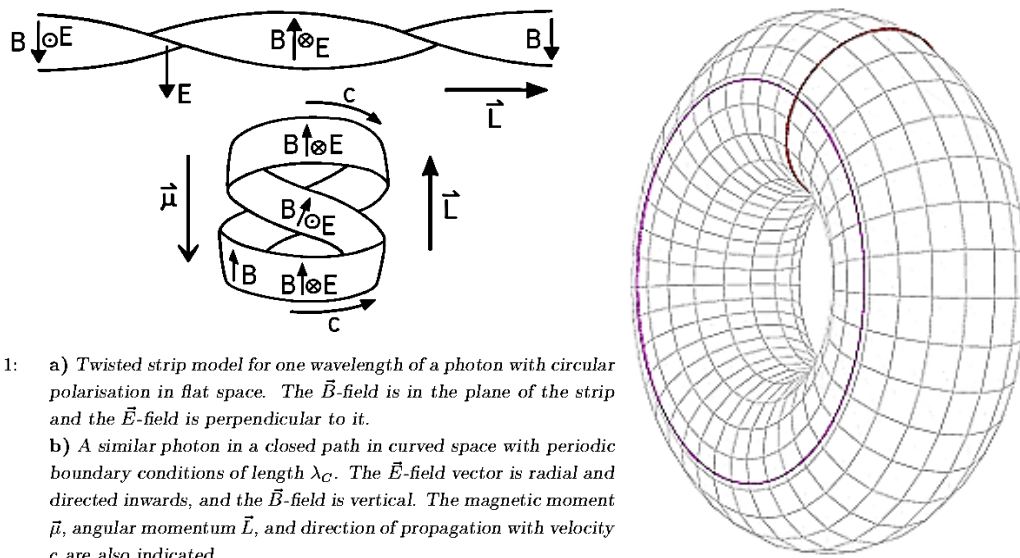
A university team (Williamson, van der Mark – Glasgow University) has modeled in detail a toroidal Photon formation that produces the expected radius, spin, charge and other properties of the Electron. The Torus, interestingly, is the simplest Calabi-Yau shape conjectured by String theory for the extra dimensions, so is quite fitting for our simplest particle. The photon

goes around a strip forming a double loop, with one side of the strip always facing outwards, resulting in its charged aspect, as well as the magnetic moment. For a moving electron, the frequency & phase shifts of the rotating photon can also provide a basis for De Broglie's matter wavelength. Two degrees of Freedom reflect the E & B fields, the equipartition principle splitting the photon energy among them.



Positron as a Rotating Photon (J. G. Williamson)- “A full model will fill space with tumbling toroidal shells and be spherically symmetric”.

“The model suggests a possible origin for both charge and half integer spin” (given the integer spin of the photon), while explaining the size of the electron, providing a fixed charge and angular momentum even while increased energy “winds up” the photon and shrinks the rotation horizon (explaining the observed variance in lepton dimensions in varying experiments).

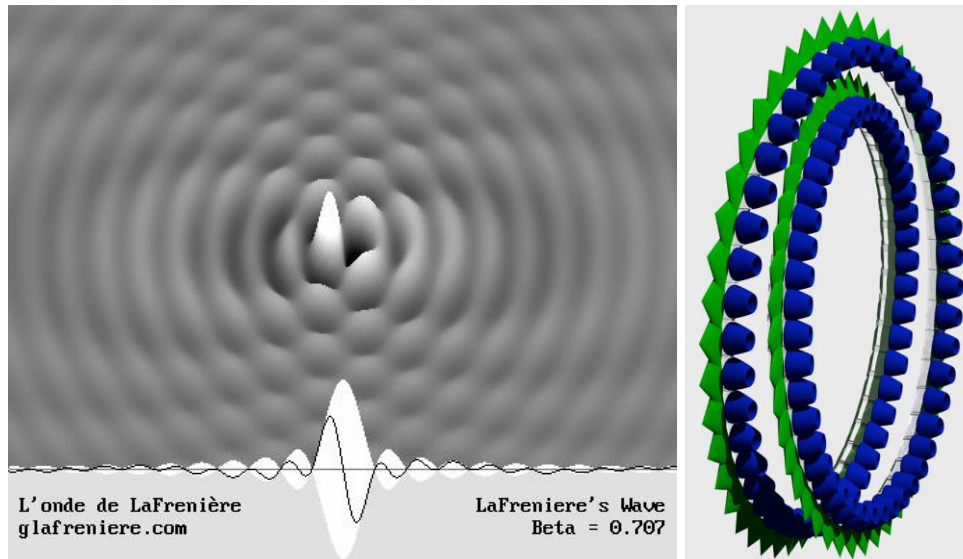


- 1: a) Twisted strip model for one wavelength of a photon with circular polarisation in flat space. The \vec{B} -field is in the plane of the strip and the \vec{E} -field is perpendicular to it.
- b) A similar photon in a closed path in curved space with periodic boundary conditions of length λ_C . The \vec{E} -field vector is radial and directed inwards, and the \vec{B} -field is vertical. The magnetic moment $\vec{\mu}$, angular momentum \vec{L} , and direction of propagation with velocity c are also indicated.

This configuration parallels Wigner's "Polarized Vacuum" idea, which incidentally also relates the mass to the polarized configuration. One more hint: Hiley & Bohm's "picture" of matter and their "ontological interpretation of the Pauli equation" consists of point particles executing a circulating motion in their movement – adding a "circulating current to the velocity of each particle". Williamson's model takes its hint from the obvious; $e^+e^- \leftrightarrow \gamma \gamma$. A scalar field is proposed that, when incorporated into a modified set of Maxwell equations, leads to "the possibility of rapid rotations of the electromagnetic momentum density, leading to self-confinement of electromagnetism". Think of this field as our PL field, a Higgs field of sorts. This "new field is an integral part of the dynamics of an elementary particle, strongly confined within it, and transmitted to the site of other elementary particles only by photon exchange". The half/integer spin and the quantized charge depends only on the resulting topological configuration (and the relative scale of the major and minor axis) of the "circulating self-contained electro-pivot-magnetic wave", aka the electron. The scalar field, aka the pivot term, is also seen as a possible candidate for Dark Matter. The rotating photon abides by De Broglie's "Harmony of Phases" ("from which quantum mechanics was derived in the first place"), with the fields returning to their starting position only after a double, 4π rotation. The rotating radial electric field (the lowest-energy solution) is what provides the quantized charge aspect. The transfer of energy and charge interaction between electrons is seen as an exchange of the scalar field elements, seen as field photons.

While the shape of the vortex is toroidal in momentum/phase space (our isolated patch), its projection on 3D space is "spherical, as the free electron has nothing to rotate about but itself" (Williamson). The energy dynamics of parallel versus anti-parallel spin can also help explain Pauli's exclusion principle.

The proposal solves many enigmas, getting charged particles from chargeless photons, creating fermions from Bosons, acts point-like while being extended, explains rest mass and quantum spin, and forms a recipe for many possible particle configurations.



An actual image of an Electron wave

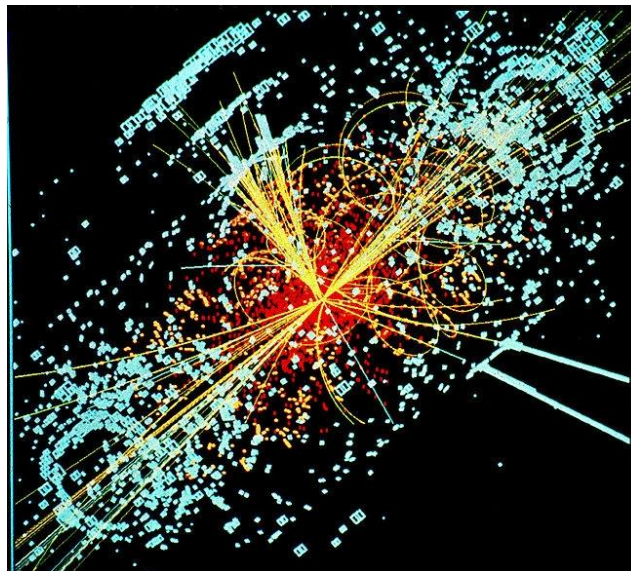
- Since the phases of the electron are unknown, and the rotating photon speed varies $\pm c$ at twice the Compton frequency, the standard uncertainty relations are reproduced.
- An Electron is a single wavelength photon vortex, in a double strand loop. By varying the number of strands in the loop, and the number of photons circulating, one can build up the various particle configurations
 - Williamson’s calculations show mass coming up within a few percent of measured values. “Rest Mass” is a result of confinement of energy (see van der Mark’s “Light is Heavy” – also discussed later). Particle generations could be seen as “tighter” (double, triple) loops, with quarks as overshooting loops transforming. The topology looks like 3D, while internally many dimensional spaces are superimposed).
- In short, an electron is a Single wavelength, resonant harmonic photon in a tumbling toroidal topology – a purely electromagnetic self-recreating object, whose “blades” are electric, with a magnetic orthogonal component. Field disturbance create the vortices-photons, which then create the electron when looped. Williamson and van der Mark call it “a light alternative to string theory”.
- Those stable matter particles can be seen as “resonances” in space. Our modern Standard Model lists a host of particles, but also a list of “resonances”, fleeting, ephemereal “thingies” we don’t honor with the name particle. Think of them as random burps that do not have the harmonic solidity of the particle resonance. They are vibrations in the

space matrix that fade out as they propagate, instead of the particles who propagate in a “resonant, harmonic” specific geometric configurations that is self-sustaining – one reason Planck and others could model quantum systems as harmonic oscillators. Those particles would exhibit groups of space and time translations and rotations compatible with Lorenz or relativistic invariance. The Electron and Positron, like other “stable” particles (Schroedinger’s electrostatic and magnetostatic models), are just such configurations of PLs that start a stable “dance” (rotation geometry). “Music of the Spheres” all over again.

- Quantum simulations of the “Grid” (PL mesh) in fact look for the self-generation of those transient localized concentrations of energy – and they find a mix of stable configurations (which translate into protons, neutrons, and other stable particles) and unstable bundles which eventually dissipate (unstable particles- aka resonances).
- The PL Electron bundle would now “rotate” as it clicks. This would give the Electron its “spin”. At the same time, the rotating clicks “slow down” the apparent “forward” motion, since the clicking is not forward in the space mesh, but circular as well as forward (the click “rate” being the defining constant of nature). As we add Kinetic energy to the bundle, you can think of it as increasing the number of PLs in the bundle, which would tend to “lengthen” the circulating packet- the increased length would then result in asynchronous rotation, causing a forward slide – Motion. Alternatively, those additional PLs form a “PL Wind”, an Airy wavepacket that pushes the rotating bundle forward.
- The Slowed down bundle now looks like matter, just because it is slowed down (appropriately called Tardyons, $v < c$), and can now be “caught up” with other slow bundles, and interact with them, something the fleet Light PL bundle (the Luxons, $v = c$) would not allow. The extreme case of low temperature (energy) would lead to a single Einstein-Bose state, as those bundles come to a “stand-still” and dance in unison. Hypothesized Tachyons ($v > c$) may not exist.
- As J.J. Thomson and Max Abraham (as well as Wien, Lorentz, and Poincare) thought, the effect of this “electromagnetic induction effect” is what gives rise to our perceived “inertial mass”. More recently, Haisch, Rueda, and Puthoff (1994) proposed a similar electromagnetic conception of mass, with the quantum vacuum (or zero-point field) (our

PL space mesh) inducing the inertial effect via stochastic electrodynamical processes – the acceleration of the particle in the zero-point field distorting the field, experiencing in the process a Lorentz force proportional to the acceleration (a-la David-Unruh effect – the acceleration equivalence of gravitation’s Hawking radiation).

- This configuration would store the algorithm of its formation and its Hilbert space correlations- basically its “wave function”, which can be manipulated and measured as “Qubits” for information processing.
- The rest mass of matter would characterize the local energy of the PL packet rotation and spin- i.e. the minimal stable configuration for a stable dance in a localized part of the space matrix. It can be interpreted as the “Number of PLs” in the minimum stable particle configuration – its “Energy of Being”.
- In many ways, Mass can be seen as an “extra” dimension, its density at a PL node being the “distance” in that extra dimension- many QM equations already use Mass (and Energy) as that extra dimension. As Lorentz had sought, and Abdus Salam demonstrated (“Progress in Renormalization Theory since 1949”), a (gravity-modified) electromagnetic self-interaction accounts for all the mass and inertia of the electron, and the “bare” mass of the electron is zero, also accounting for the small order of the Newtonian constant.



- As the bundle acquires “energy” (additional PLs that are not part of its stable geometric configurations), those PLs in their motion result in spacial displacement of the bundle overall (like pesky extra dancers

moving the square dance as they try to cut in) - “motion” of the particle, with the additional PLs as its “Kinetic” energy. Imagine a sea breeze pushing the waves, or an unfolding wrinkle in the carpet pushing a ball along. “Mass” then is interpreted as the property of resistance to an acceleration - the more PLs the bundle has, the harder it is to displace in “space”. To get the bundle moving close to the speed of light (the normal speed of the PLs) would require an immense number of PLs moving the bundle – reaching the speed of light would mean the disintegration of the packet, since that speed implies free PLs (Photons) traveling in wave packets instead of a local resonance. (A lesson perhaps in the value of “Freedom”: it takes an Infinite amount of Energy to “force” a coordinated packet (particle) to move at the speed of light, but if you Free those PLs (say by having an anti-particle (revolutionary) join a particle) they will immediately zip into speed).

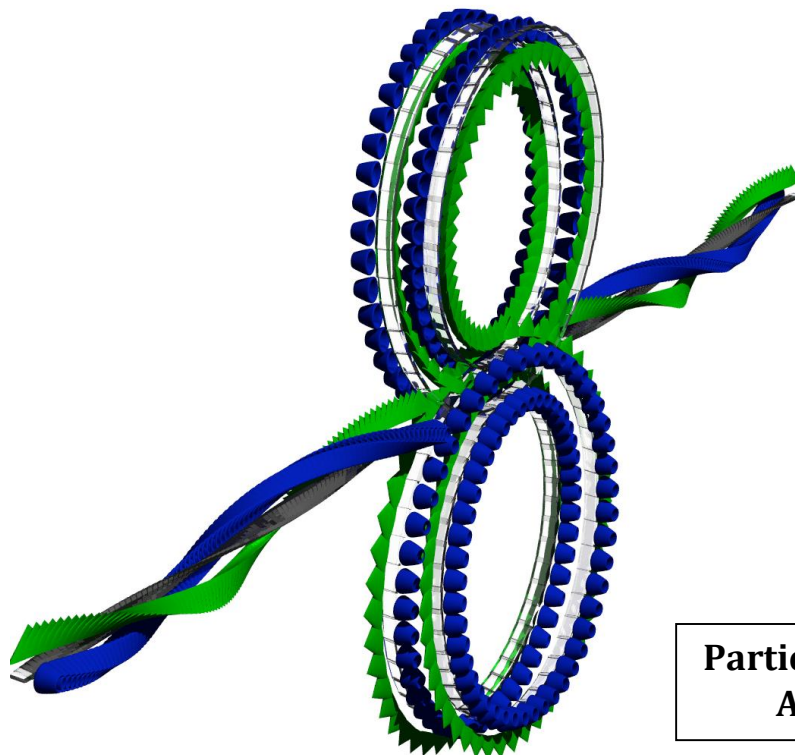
- The setup of the rotating PLC configuration could be the perceived role played by a Higgs field, in the act giving the PLC an effective “mass”. The Higgs field (wave of Higgs PLs) would entangle the free PLC cluster, and the interaction of the two would start a rotational configuration, resulting in the effective “mass”. The mass imparted would be a function of the configuration. As Abdus-Salam says, “the massless Yang-Mills particles ‘eat’ the Higgs particles in order to gain weight, and the swallowed Higgs particles become ghosts” – the different “particle” configurations soaking up varying amounts of energy or mass (actually absorbing Nambu-Goldstone’s massless scalar boson). It is possible to see the Higgs field as basically the same as the flat space PL field with which the PLC interacts and moves in, and the “Higgs Particles” being Netherworld PLC clusters ready to be materialized in our world when other PLC clusters present themselves. The “Weak” forces are basically “Weak Photons”, of the same structure as a Photon, but their dimensional and configurational aspects cause them to present a “mass” unlike the apparently “free” massless photons of EM.
- One view of particles could be as miniature Alfven waves, kinks/Kink waves & pinched currents; and similar to those waves, the velocity approaches the speed of light at low density, as in photons and neutrinos.
- The “Spin” configuration of the particles would result from the particular “geometry” of the PLC (read correlations/algorithms for the

cluster in the Hilbert Existence space). Depending on the geometry, different spin values would characterise the way the PLCs would interact with each other, giving Bosons their gregariousness, and Fermions their uppity attitude- implying the correlations of the algorithms encourage divergence of the respective Hilbert Space bundles. The various spin/quantum numbers lead to the shell structures, evident in electron orbits, and well as within the nucleus.



- Already in classical electromagnetism, we have clear indications of the EM causes of inertia, where “the electron exerts a force *on itself* that tries to hold back the acceleration, It holds itself back by its own bootstraps” (Feynman), just by the field effects of its charge. The EM mass due to charge is also visible in the difference in mass between charged and uncharged pi-mesons.
- “No doubt much of the mass of an electron compared with its neutrino partner, for example, comes from the energy of the electromagnetic field it generates because of its electric charge. Turn off the charge and it would look very like a neutrino. Same with the up and down quarks” (Marburger).
- The idea of the dark energy being part of matter goes as far back as Einstein, who in 1919 suggested the cosmological constant might play a role in atomic theory. In 1927, he suggested a classical model of electrically charged particles with a negative pressure in the interior, related to the cosmological constant. Weyl had toyed with similar ideas, later indicating to Einstein that “all the properties I had so far attributed to matter by means of Λ are now taken over by quantum mechanics”, and the thread was dropped.

- De Broglies's formula p (momentum) $=mv$ (velocity) $=h/\lambda$ (wavelength) for the duality of matter and waves, contains hints of the structure proposed above. The rotating wave moves forward at a velocity v , that rotation and velocity creating a corresponding wave of Pilot PLs (De Broglie Pilot waves) with a frequency proportional to the velocity pushing it forward. It is also proportional to the mass, since the mass (the source of the Pilot PLs) also drives the "PL density" (read "pressure") which affects the wave frequency. De Broglie beautifully compared this (a very apt analogy) to a musical instrument that can emit a basic tone and a sequence of overtones- think of the circulating wave being the strings, and mass the tension of that string. He saw the "particle being a little localized object incorporated in the structure of a propagating wave", his pilot waves. Every small particle is thus associated with a wave propagating throughout space. The Electron Pilot PLs would constitute the "Electron Field" permeating all of space time.



**Particle- Antiparticle
Annihilation**

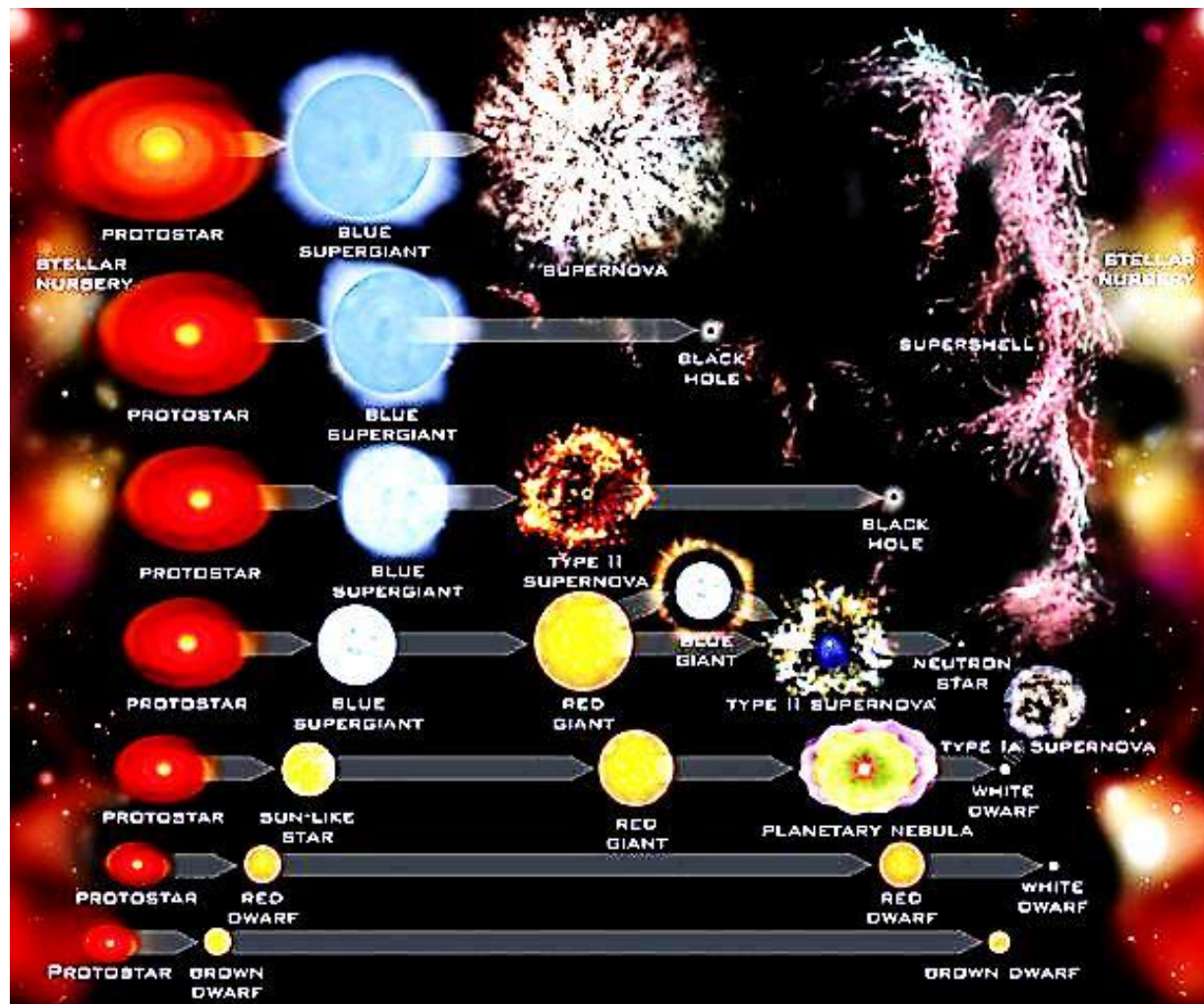
"To have an electron in a certain region of space means ... to have in this region a systematic but localized oscillation, responsible for all the manifestations here which define the properties of the electron (charge, mass, momentum, angular momentum, etc.)." - Brian Greene

3.6.2 A TOOLKIT OF MATTER

The Different Particles possible to come into existence as such would depend on the geometry of the space matrix (i.e. the active set of relationships between the nodes), and how many stable configurations (“stable limit cycles” – Bohm & Hiley) are allowed/sustainable (One can imagine many “resonance” types, ephemeral particles forming and then dissipating in the fabric). Electrons, Quarks, etc, are those stable configurations. A good analogy is the star types that come out of their main sequence: white dwarfs, black holes, neutron stars, etc, resulting from the “size” of the initial formation and how much the end product can sustain. The Cornucopia of basic particles would come out of this maelstrom. Alvfen type turbulences (hard enough to pin down in a macro world) would play out in the PLC creating those apparent “basic” structures. This is reminiscent of Geoffrey Chew’s “bootstrap” model and S-Matrix Theory, where the “elementary” particles are simply mathematical relationships between the different configurations that would arise from the scattering and turbulence of the initial broth, constrained by the “laws” of QM and relativity considerations that govern their interactions.

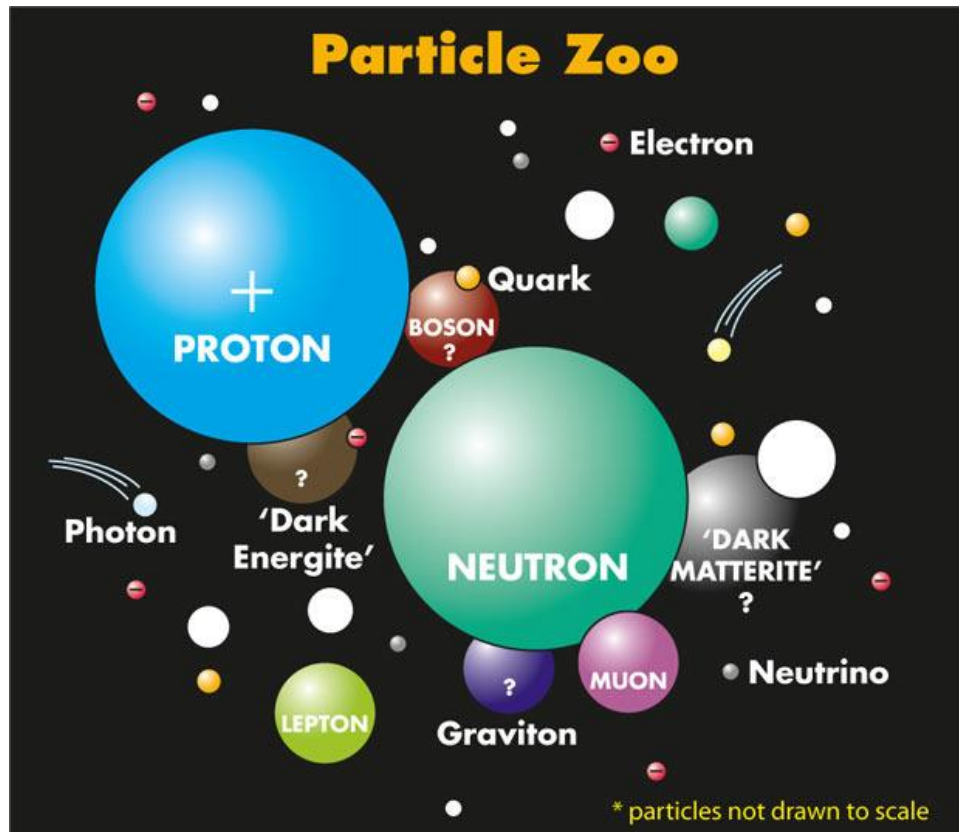
The PL clusters, like forming Nebulae, end up rotating and forming particle packs of different “categories”. Similarly, using the same analogy, it is possible for the particle/anti-particle pair to collide (like two neutron stars), the new formation being unsustainable, with the resultant “explosion” returning the PLs into their “Free” light formation. Electrons, like collapsing stars, would have a fixed identical formation, as collapsing stars have a Chandrasekar limit to form white dwarfs and Neutron stars- the “minima naturalia” of old. Nature, using the same set of basic simple rules, tends to repeat its successes at all scales – from Rutherford’s atom, to Solar systems, PL Clusters and Galaxies alike (as Feynman says: “Nature has only one way of doing things, and She repeats her story from time to time”). Heraclitus summarized it: “The way up is the way down, the way down is the way up”. The old idea that physical entities that satisfy the same relations are ultimately alike, is a new idea again, much of Physics & discovery being based on its truism. Einstein’s conception of the photon was driven by his comparison of the mathematical similarities of formulae of the entropies of radiation and ideal gases. Smolin sees “that there must be a role for the physics of self organized systems in cosmology and particle physics”, where “self-organized critical systems, which are non-equilibrium systems that spontaneously organized themselves in

configurations characterized by approximate scale invariance over a wide range of scales, without the need for any precise tunings of parameters”, emulating cellular automata and a “game of life”. See the electron as a miniature Quasar, spinning material around its core, generating a magnetic field and a spin.



Such systems are aspects of “self-organized criticality”, operating at the edge of chaos, to use Per Bak’s, Langton’s and Kauffman’s favorite catchphrases. “Coupled Dancing Landscapes” (Kauffman) spontaneously approach criticality, usually demonstrating a power law distribution. “Systems that are far from equilibrium become critical through self-organization. They evolve through transient states, which are not critical, to a dynamical attractor poised at criticality ... The system jumps from one metastable state to another by avalanche dynamics. Those avalanches build up long-range correlations in the system” (Bak). Those attractors are a subset of phase space to which the

solutions of non-linear differential equations eventually converge, starting from an initial “basin of attraction”. These attractors act as “lures” for trajectories in phase space, and often show scale invariant behavior. From the Great Attractor galactic region within the vicinity of the Hydra-Centaurus Supercluster at the center of the Laniakea Supercluster, to whirling Galaxies, Solar Systems, and down to whirling PL vortices forming electrons and photons, their fractal nature and power-law distribution are demonstrated.



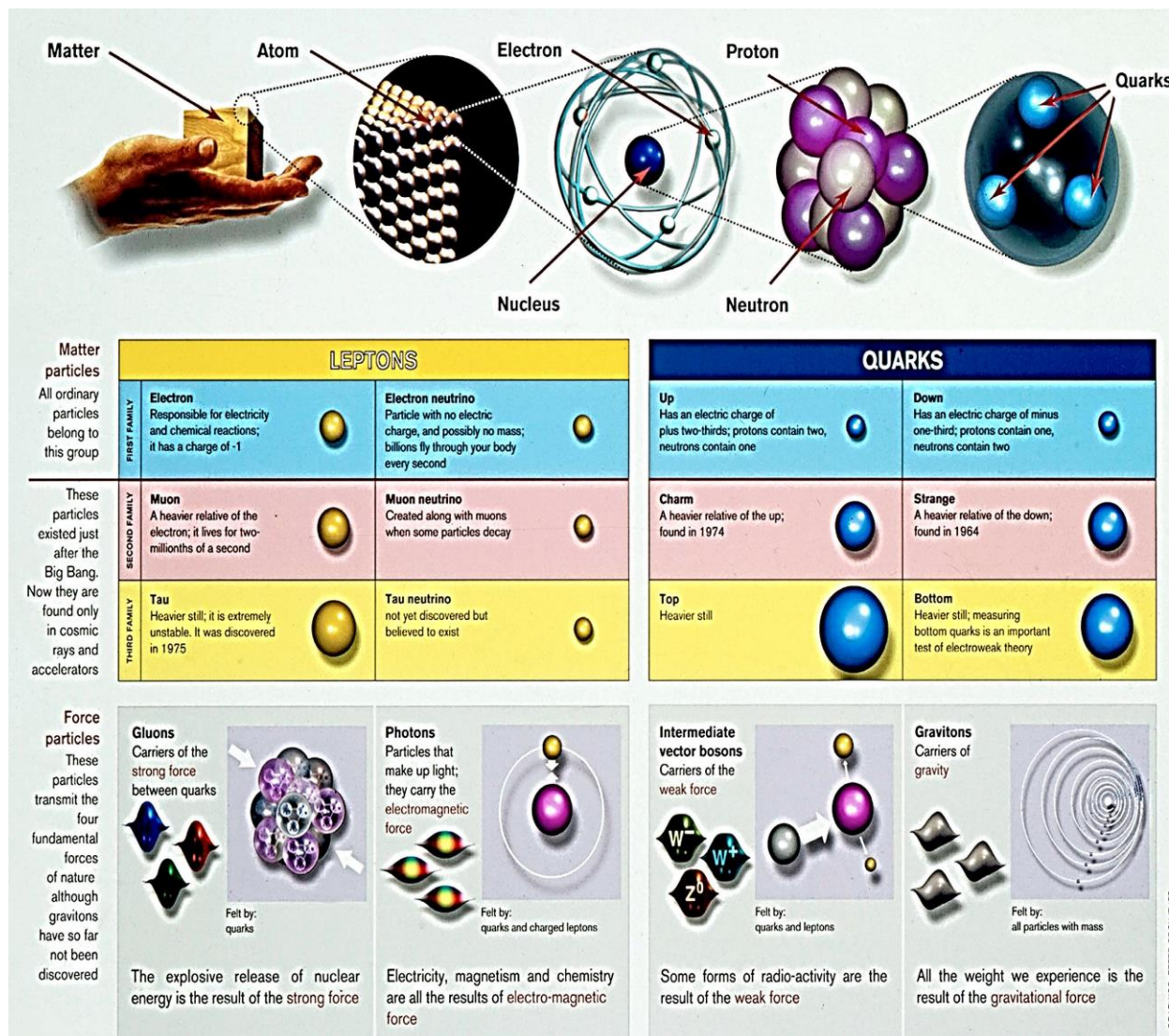
- Those clusters of particles would form in the dimensions appropriate to their “Charge” or “Color”, but still project on our 3-dimensional world with their conglomerate “mass” and EM effects. The multiple “dimensions” in Hilbert Space allow for many similar clusters obeying symmetry laws, yet with different emanent “properties” due to their configuration in a different dimension. Electrons would be trapped photons in the EM dimensions, Quarks trapped “Gluon” waves in the Color dimensions, and Neutrinos trapped waves in their Weak Color dimension. Those dimensions, whether tightly compacted circles or extended, we would not “see”, since our “detectors” are all based on EM waves and “mass” (kinetics) – Alternatively, we could claim we DO see

them- by their neutrino, quark appearances and effects. We don't see them in cms and meters, BECAUSE they are NOT measured that way in Hilbert Space. Centimeters and meters are our kinetic measures in the 3-dimensional emanent world using Light straight rays, and do not apply to those ("mathematical" if you like) dimensions. Being Mathematical does not make them less real, since we, made of PL "Logic" entities, are also Mathematical entities. We see them the way the people of the Cave in Plato's allegory saw the world through its shadows on the wall, the wall in this case being our 3-dimensional space- an apt analogy since the shadows are formed by light's edges.

- The internal dynamics of the particles are not visible in our frame of reference, since their "internal" entanglement presents them to us as one quantum entity, for which time/space is stopped. Only an "internal" observer within the particle "bubble" can see their motions & space-time. This is in line with recent evidence of time being an internal aspect of an entangled system, not visible for external observers (Moreva et al.). What we see is only "static" externally referred properties (like charge and magnetic field), frozen in time at the boundary of the particle.

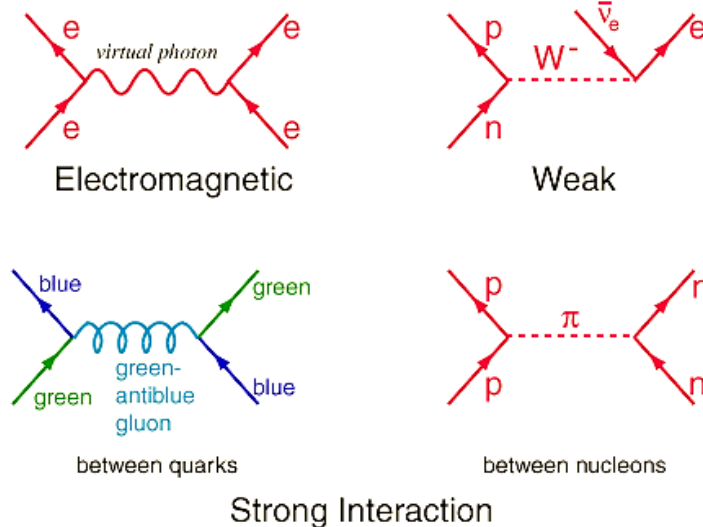


Escher – Smaller & Smaller



- A particle (e.g. Fermion) is not placed within an existing classical space structure, but floating in the randomized Hilbert Space. The rotating PLC creates a point like singularity with spin $\frac{1}{2}$ (Ehrenfest Paradox – see appendix), a return to the “vortices” of yesteryears – Hurricanes and Tornadoes in space time, while “organizing” the PL nodes around it – defining its own little piece of space-time. The overall Euclidean space then derives its form from the combination of these little islands of order in their interactions. This initial island formation provides the randomized direction of spin between ensembles of particles, once the overall space has been formed by their interaction in a multipli-connected space incorporating all the singularities.

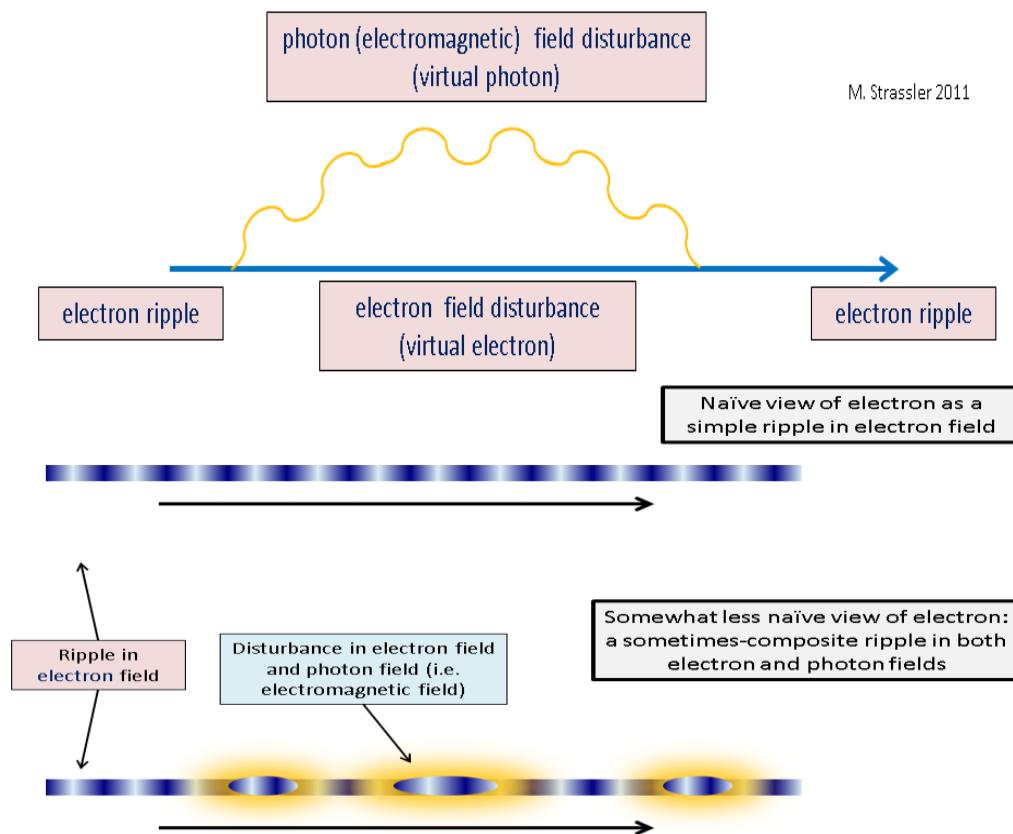
- On a larger scale, Fractal effects appear – from the smallest structures to Galactic Clusters.
- A photon packet, when it hits an “electron” stable-PL-formation, bounces off- the “clicking” rebounds in a different direction; At the same time, the Electron bounces off too, its rotating bundle shifted accordingly. The rebounding action is essentially a “turnaround” in PL formation and direction of propagation, the “momentum” transfer essentially an exchange of PLs (Feynman’s virtual Photons or equivalent).



- Alternatively, the “Particle” can “absorb” the impacting, relatively free, dissociated PLs of the photons, integrating them into its appendage structure, essentially gaining the kinetic “Energy” (momentum of motion), thereby accelerating its own movement in that direction.
- Historically, the concept of mass as being the “electromagnetic” mass was hinted at by JJ Thomson in his calculations of the electron mass. Oliver Heaviside and George Francis Fitzgerald expanded that insight, suggesting the possibility that our concept of mass in mechanics could be derived as emanent from convection currents and corresponding electromagnetic radiation, removing the “stuff” concept of matter. Walter Kaufman and Max Abraham went further to prove the “bare mass” has no real existence, and the “inertia of the electron originates in the electromagnetic field”. Such views align with our PL picture of a world of light, the electron being a whirl of PL currents, giving it its effective “drag” or “inertia”. The speed of light, c , could then be

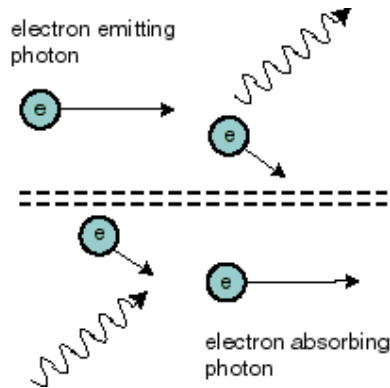
interpreted a-la Landau and Sampanthar as a “constant of integration” measuring the rate of “coalescence” of a particle, and that the velocity-dependence of the mass in relativity is a natural outcome of this, with “c” being an upper limit for any positive mass particle.

- The mysterious “virtual photons” that crowd around an electron are therefore less mysterious, if they are made of the same stuff. In fact, given the transient existence of the PLs, the electron “cluster” could easily have local neighboring vibrations of its components, that drift off the main concentration in a dance we interpret as virtual particles coming in and out of existence.



- Wilczek, in the “Lightness of Being”, proves 95% of mass (at least) is in a body’s Energy- showing this in detail for quarks, the main constituents of Neutrons & Protons, in turn our main constituents. We propose the remaining 5% also is the same stuff, all EM & color fields in various configurations, all made of the same PLs. All Mass is Electro-magnetic.
- Carver Mead sees electrons and photons as wave functions, attributing their particle-like behavior to quantization effects. All “matter” particles are not particles, but pure waves of matter.

- The equations of QM are remarkably similar to the equations of the kinetic theory of molecules and statistical mechanics. In some cases, Planck's constant, QM's mainstay, plays a similar role to temperature. It almost seems like QM is describing a kind of "gas" or ensemble of "molecules" of more primitive entities that compose matter (our PLs??).



- The definition of a "fundamental" particle has to be reconsidered. Are all electrons the same? Aside from having an identical charge (explained by their rotating structure and quantized photon structure), they are not. When an electron absorbs a photon, it is still an electron. It is the old electron, plus whatever it took from the photon. It is not the same. We may read the photon addition as kinetic energy, but that also translates to mass. You can think of the new combo as an electron being "pushed" by the photon field (basically, the warp created by the photon, unrolling through space, moving the electron along). Similarly, a decelerating electron gives out photons (basically pushing off warp, to reduce its speed). But the combo is not the same as a "pure" electron. If we consider the "pure" electron as an electron at rest, a circulating photon, then a moving electron is a pure electron being pushed by the photon fields tied to it – basically more PLs that got absorbed, whose linear motion "pushes" the electron configuration forward in space. What keeps it an electron is the rotating EM picture and the fixed charge aspect, but the rest is different, basically more PLs in a different configuration.

As Geoffrey Chew highlights, "A truly elementary particle-completely devoid of internal structure- could not be subject to any forces that would allow us to detect its existence. The mere knowledge of a particle's existence, that is to say, implies the particle possesses internal

structure". Chew's scattering S-Matrix approach advocates a "nuclear democracy" where all particles are equally fundamental – and he counts over 18,000 such particles, including mesons, baryons, and a majority of "hexons" (particles with six topological constituents). Heisenberg preferred "to formulate it paradoxically: every particle consists of all other particles", preferring to replace the concept of a fundamental particle with the concept of a fundamental symmetry, which defines the underlying law which determines the spectrum of elementary particles. "The states called elementary particles are just as complicated as the states of atoms and molecules". The Standard Model presumes this- *"each elementary particle we actually observe is a combination of all the pieces of the Standard Model"* (Marburger). This all springs "from the same underlying requirement that Nature's laws of motion must not depend upon arbitrary choices of reference frames for internal "spaces". This is a symmetry requirement: the laws must "look the same from different points of view"". *"Symmetry dictates interaction"* (C. N. Yang). Such a definition presumes a common "stuff" these symmetries act on, which we propose to be our PL field.



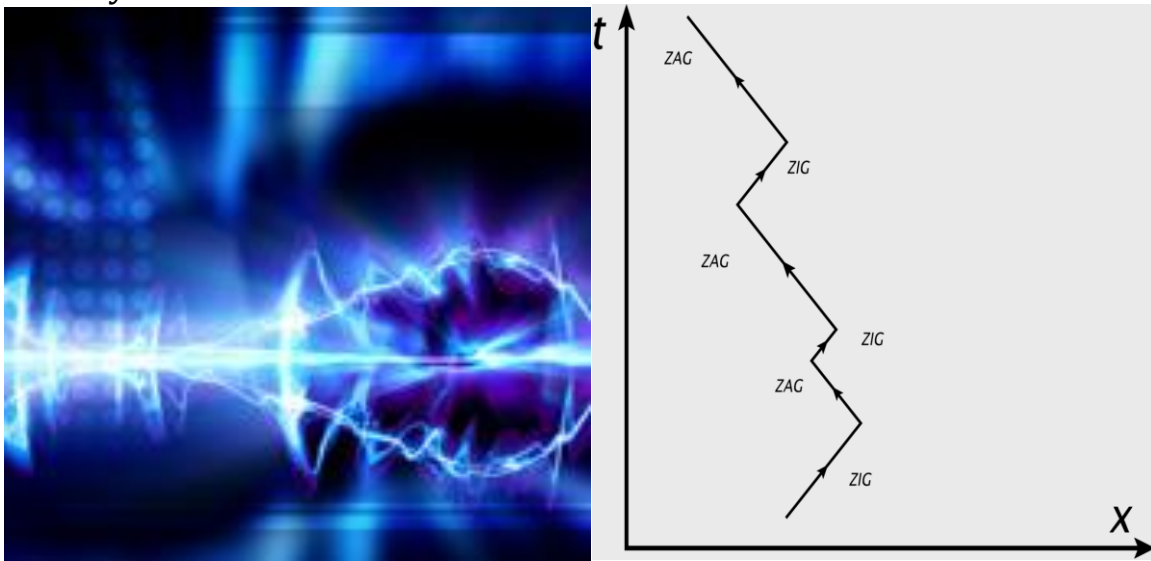
- In the beginning, all was "energy", the stable forms of matter unable to survive the high density of PLs buffeting it. Pair productions in the early universe would fall back into the radiation state, their required stable loops disrupted by the high energy environment, whereas the "free" radiation mode was not so hindered. As the Universe expanded and cooled, the particle formations became possible, and here we are!
- Charles Galton Darwin (grandson of the Darwin) had proposed a "light-like description" of the electron as a vector wave, much like our proposal. (Pauli, of course, preferred a matrix approach to "avoid the danger of visualization of electron spin"! – both approaches yielded the

same mathematical results). Darwin represented spin via polarized de Broglie waves, and noted “an interesting unity between the electric charge and the magnetic moment”. He also had recourse to the Thomas factor of 2 for the gyrometric ratio, “a blemish in geometry rather than dynamics”. Relativity plays an important role in modeling the spinning electron, and with relativity being essentially a “point theory”, “relativity and rotation do not take at all kindly to one another” ☺ (Darwin).

Another clue to the EM nature of particles: the Standard Model and Quantum field theory assume all particles (being fundamentally massless, until interacted with the Higgs field) travel at the “speed of causation”, the speed of light. Particles moving at lower speed only appear to do so, because they follow a zig-zag motion (Penrose), which also gives them the “appearance” of having mass as well. Those models have been also studied in conjunction with the Pilot wave models. Dirac’s studies of the motion of electrons pointed at two parts: a relativistic motion of the electron as a whole, and an oscillatory part of twice the Compton frequency (later dubbed Zitterbewegung). Well, what if that motion was actually an undulatory circular oscillation, instead of a zig-zag, a more favorable event given their wave characteristics? Our rotating photon image is a better, more natural fit, with the same effect. Dirac had further noted that “any instantaneous measurement of any component of the electron velocity will always yield one of the eigenvalues $\pm c$ ” (Williamson), while the lower velocities we observe are “always average velocities through appreciable time intervals” (Dirac). In fact, “a measurement of a component of the velocity must lead to the result $\pm c$ in a relativistic theory, simply from an elementary application of the principle of uncertainty...”. Besides, that speed has to be periodic, “the oscillatory part of the motion here displayed giving rise to an oscillatory term in the angular momentum”, resulting in spin, as long as “the position of the particles is an observable” (true for matter, not radiation) – “the particle must have a spin angular momentum of half a quantum” (Dirac) and a corresponding magnetic moment. Our circulating “light-speed” photon fits this to a T.

The same view is reflected in “Zitterbewegung”, that trembling motion proposed by Schroedinger, where “interference between positive and negative energy states produces what appears to be a fluctuation (at the speed of light) of the position of an electron around the median, with an angular frequency of $2mc^2/\hbar$.” This effect, simulated in ion-traps, describes well our oscillating rotating photon proposal, where the “negative” energy state is the –ve modulation part of the EM wave of the

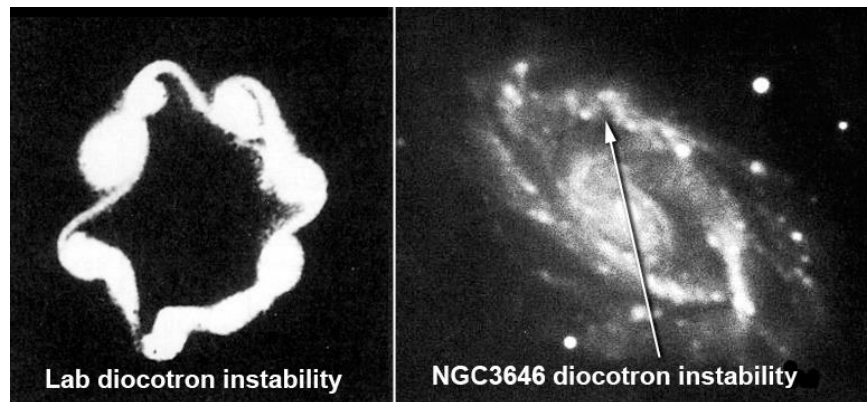
photon (the “anti-matter” part of the photon). Dirac’s time dependent electron equation contained an unexpected oscillation term with an amplitude equal to the Compton wavelength, that oscillation term being the so-called “Zitterbewegung”. More recently, Hestenes (Zitterbewegung interpretation of Quantum Mechanics) uses Zitterbewegung to interpret the half integer electron spin, and sees the trajectory of a moving electron as a series of light-like helices, reflecting the rotation of the electron energy-momentum, similar to the path a torus electron would mark. Nature’s Clues have been ignored repeatedly.



- An interesting point of view arises when we compare our microworld EM vortices with the Galactic Plasmas that pervade the Universe. While Plasmas are some of the hardest things to simulate and mathematize, their behavior at macro scales can be instructive of what to expect in the EM storms of the micro-world. Plasmas in space are “quasi-neutral”, as a photon would be. But at the boundaries of Plasmas of different characteristics or charged objects, a “cell wall” or “double layer” DL (Langmuir Sheath) of opposite charge is formed, across which a voltage is generated (say... like the wrapped photon exhibiting an external charge??). Plasma “cells” moving relative to each other induce electric currents in each other (say... like electrons passing by each other??). Peratt’s supercomputer simulations show that interactions of Birkeland filaments naturally produce an accumulation of matter at the currents intersections (say... like photons creating electrons or electrons and positrons creating photons??). Plasma Filaments will form “twisted ropes” due to their magnetic and electric interactions, and as they draw

together, they rotate faster and faster, creating an electrical whirlwind, a plasma vortex – a most stable, efficient energy transmission mechanism in its “Birkeland currents” (say... like photons creating electrons??). Hannes Alfven’s Magnetohydrodynamics deserves a second look.

- The scalability of electromagnetic phenomena is shown by matching “diocotron” instabilities in a 58-microampere beam of electrons to plasma instabilities in galaxies. On an even larger scale, G. Verschuur sees that “upon closer inspection, certain features in the WMAP maps look hauntingly familiar to those who have spent their careers studying the HI and radio emission from the Milky Way galaxy”. The electromagnetic behavior of Plasma makes it very different from the matter we are used to, and we live in a Plasma of sorts – the PL Superfluid that makes up Spacetime. Maybe, as Talbott and Thornhill say, we do “live in an Electric Universe”.



- Feynman emphasized: “(1) the electromagnetic theory predicts the existence of an electromagnetic mass, ... (2) there is experimental evidence for the existence of electromagnetic mass; and (3) all these masses are roughly the same as the mass of an electron. So we come back again to the original idea of Lorenz- maybe all the mass of an electron is purely electromagnetic, maybe the whole 0.511Mev is due to electrodynamics. Is it or isn’t it? We haven’t got a theory, so we cannot say”. I say we have a theory.
- “The basic fermions of the Standard Model, 3*6 quarks and 6 leptons, all resemble the electron. They each have two components of spin, and in the absence of interactions their wave functions each obey Dirac’s four-component version of Schroedinger’s equation which pairs objects and

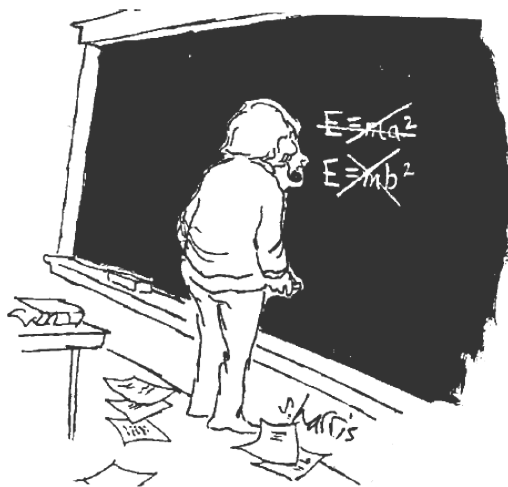
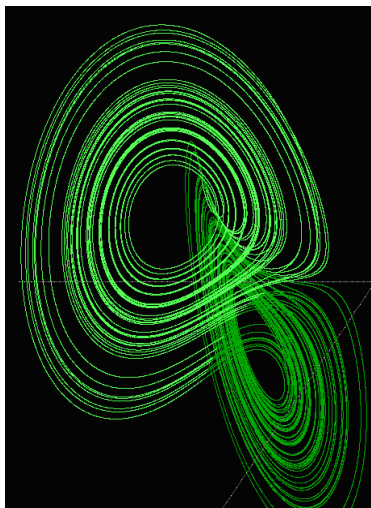
anti-objects in one multi-component expression. They differ only in their masses and in the type of charge they bear: electric, weak, or strong. Perhaps they are not really different, but just different manifestations of the same underlying entity” (Marburger).

- As one of my favorite bloggers wrote: “Energy (rest) brightening up points of mass is space; the energy (kinetic) that rides them is time.”
- As Einstein once wrote, “the victory over the concept of absolute space or over that of the inertial system became possible only because the concept of the material object was gradually replaced as the fundamental concept of physics by that of the field”. Our PL Hilbert space is just such a field.

“On the one hand waves, on the other quanta! The reality of both is firm as a rock. But the devil makes a verse out of this (which really rhymes)!” – Albert Einstein

“According to the [field theory of matter] a material particle such as an electron is merely a small domain of the electrical field within which the field strength assumes enormously high values, indicating that a comparatively huge field energy is concentrated in a very small space. Such an energy knot, which by no means is clearly delineated against the remaining field, propagates through empty space like a water wave across the surface of a lake; there is no such thing as one and the same substance of which the electron consists at all times” –

Hermann Weyl



“Are particles nothing more than tangled plaits in space-time?” – Lee Smolin

“When the ch'i condenses, its visibility becomes apparent so that there are then the shapes (of individual things). When it disperses, its visibility is no longer apparent and there are no shapes. At the time of its condensation, can one say otherwise than that this is but temporary? But at the time of its dispersing, can one hastily say that it is then non-existent?” – Chang Tsai, Chinese Sage

"We may therefore regard matter as being constituted by the regions of space in which the field is extremely intense... There is no place in this new kind of physics both for the field and matter, for the field is the only reality" – Einstein

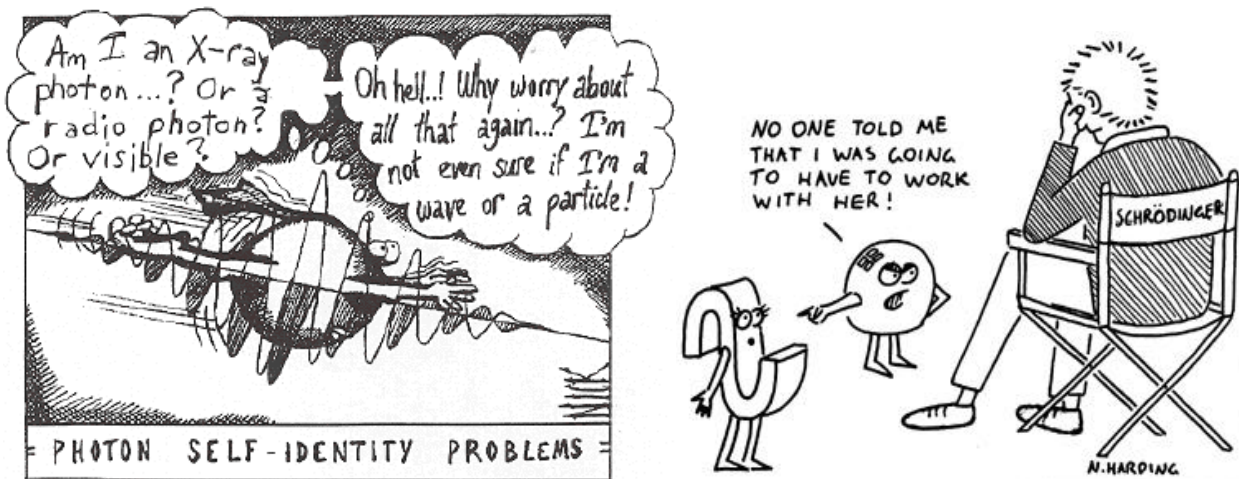
"I do not believe that a real understanding of the nature of elementary particles can ever be achieved without a simultaneous deeper understanding of the nature of spacetime itself." – R. Penrose

"In the light of the equivalence of matter and energy the division in matter and field is something artificial and not well defined. ... Matter is where the concentration of energy is high, field is where the concentration of energy is low. But if this is the case, the difference between matter and field is quantitative and not qualitative".

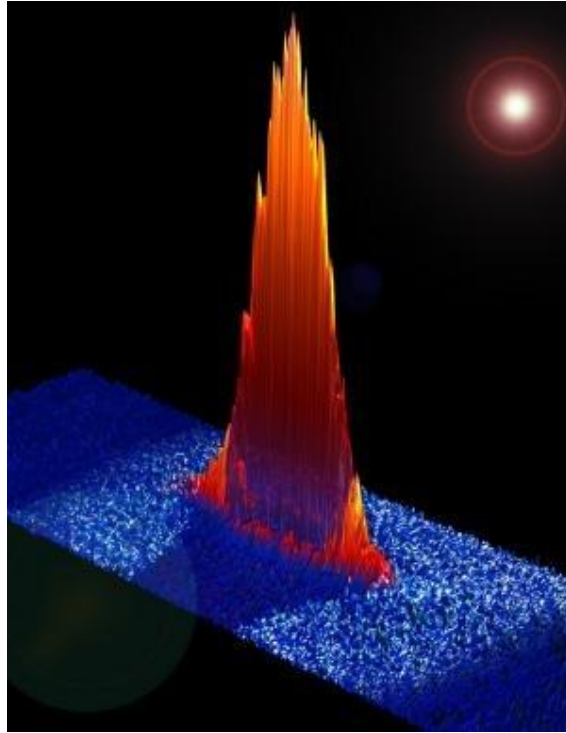
– Einstein & Infeld

"You see what tight knots people have gotten into in trying to get a theory of the electron!" – R. Feynman

"The fact that wave and particle are never found separately suggests instead that they are both different aspects of some fundamentally new kind of entity which is likely to be quite different from a simple wave or a simple particle, but which leads to these two limiting manifestations as approximations that are valid under appropriate conditions". – Brian Greene



Takeaway: Radiation (EM)/Photons are oscillating PLCs in an additional dimension. Electrons are photon loops. Quarks and other particles are similar color photon combinations (potentially in different dimensions).



This is a 3-dimensional projection of an image of a phase separated atomic cloud. The tall central (semi-transparent) region consists of paired fermionic 6 Li atoms, and is believed to be a superfluid. The shorter (opaque) peaks on either side, as well as the faint ring around the bottom, are unpaired atoms which have been expelled from the paired central region. The light in the background is a representation of the probe laser beam used to image this cloud. (Rice University).

3.7 - PL FLUID UNIVERSE

This set of Logical Particles, floating in a Hilbert Space of their own formation, forms a “PL Gas” equivalent, which can also be seen as a “Fluid” of Particles, especially in their higher density zones.

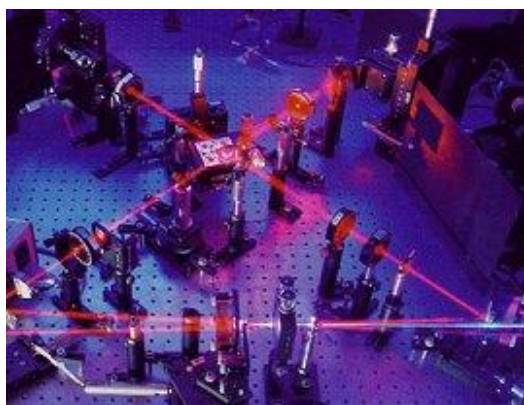
This proposal envisions a Fluid of PLs, whose numbers exceed by many orders of magnitude the number of “particles” we recognize in the known Universe, and whose emanations are those particles.

In huge Clusters, they form the photons, electrons, and everything else we “see”.

In low density emanations, they form the “Dark Matter” we do not see. At those low densities, they do not exhibit the necessary “Pressure” of the PL Fluid that drives their Clusters at the Speed of Light and creates their “electromagnetic” effect.

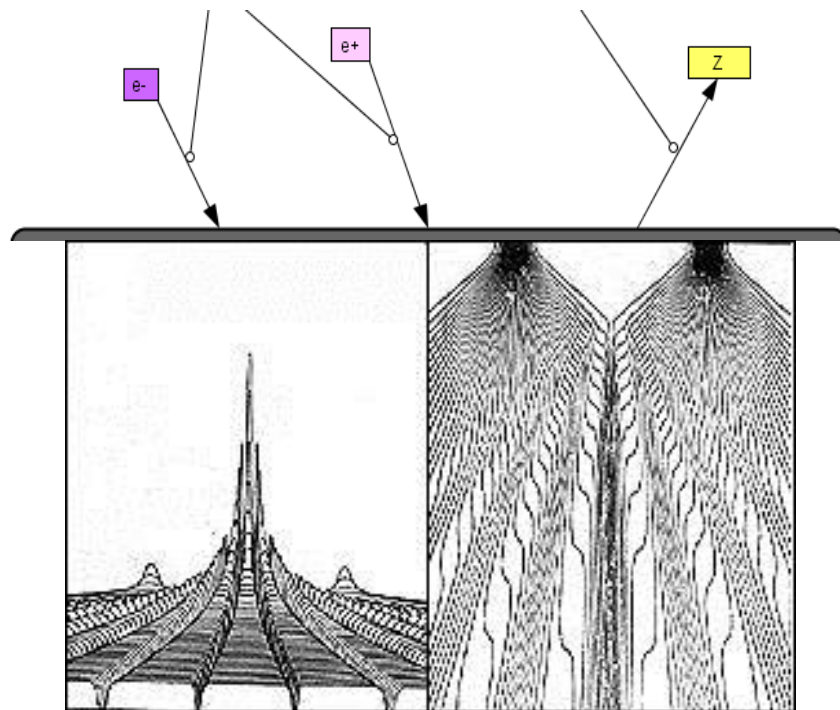
In very low densities, they form the background “Vaccuum Energy” (Space Mesh) we also do not see, but observe its indirect effects in “Space expansion”.

Their Huge numbers, coupled with their extensive Pilot Waves, are spread throughout “Existence”, their interactions creating “Entanglement” and the Quantum Non-Local Phenomena we measure.



This view calls for a “stochastic” interpretation of Quantum Mechanics, such as proposed by E. Nelson, where stochastic motions of point particles driven by a kind of universal Brownian motion statistically reproduce the predictions of Schroedinger’s equation – an idea replayed by Smolin in his “Matrix Models as Non-Local Hidden Variable Theories”, where matrix elements relate to the pollen grains in classical Brownian motion, and thermal properties (e.g. T)

relate to the number of particles N , with the off-diagonal matrix elements playing the role of non-local hidden variables. Such a matrix theory shows “the quantum evolution of the eigenvalues may appear, at Large N , to be a consequence of the classical statistical physics of the matrices”, and “we may be able to solve the daunting conceptual problems of quantum theory by means of a simple physical hypothesis: that the theory of gravity and hence spacetime arises from a non-local background-independent theory in which geometry initially plays no role and the physical degrees of freedom represent relational rather than intrinsic properties” (Smolin). “A quantum state is nothing more or less than an ordinary statistical ensemble of Brownian motion trajectories”, for “a particle which has an irreducible Brownian motion on the configuration space”. Smolin suggests that a “local degree of freedom can have its motion randomized by interaction with a large number of non-local degrees of freedom”. Nelson proposes the transition from classical to quantum pictures is due to this “dissipationless” Brownian noise. The idea has close parallels with Bohm & Hiley’s ideas for the quantum potential, and while the “noise” element exists, it does not affect the averaged conservation of energy, and the net “osmotic velocity” is “always proportional to the gradient of the probability distribution” (Smolin), a-la-Hiley.



Left: A graphical depiction of the quantum potential (Bohmian Mechanics). Right: Trajectories of an electron in a double slit experiment (De Broglie-Bohm Pilot waves).

Large numbers of PLs interact, their resulting visible laws a parallel to Brownian Motion in Fluids, or similar processes in phase-space. Schroedinger's equations are suspiciously similar to the equations of Diffusion processes and Brownian Motion. This has not gone unnoticed by physicists, including Schroedinger himself, who had a different interpretation of his equation than was eventually adopted by the QM community. (Others, including Fiirth, Fenyves, Rylov, de la Pena-Auerbach and Cetto also supported this stochastic view, and Feynman's Path Integral approach could interpret the wave function as a sum of Brownian Motion Trajectories, as confirmed by Comisar). Such a view would provide a statistical approach to physics that could form a bridge between the micro and macro world, and accommodate QM to classical physics. Eugene Wigner's work also suggested a possibility of formulating Quantum Mechanics in terms of Phase Space ensembles, a close cousin of our PL Fluid. Such a view would easily explain "Frame Dragging" phenomena, where space is seen as a fluid being stirred by the rotational motion, where the fluid tension can even be exploited in "Time Reactors" (Anderson) to extract energy from the warped fields.

Nelson proposes an amusing analogy based on Kappler's experiment of a mirror being buffeted by air molecules, with its measurements by both light and heavier particles showing its perturbations, those measurements displaying the same type of uncertainty issues a-la-Heisenberg (heavy particle causes high impact and uncertainty; "kight" light subject to large diffusion and not measuring accurately). "It does not take much imagination to conceive of physicists developing a theory that denies the reality of the mirror's trajectory and describes the angle by an abstract mathematical object, with the objects for two different times not being jointly measurable" ☺. "Quantum theory attempts to establish hegemony over all physics: according to it, all physical systems are subject to quantum fluctuations because quantum fluctuations are not physically real, being merely a consequence of a conceptual framework of universal applicability. But perhaps it is not so. Perhaps quantum fluctuations are just as real as thermal fluctuations and arise from certain interactions, and perhaps not every interaction is subject to quantum fluctuations. Stochastic mechanics and the background field hypothesis free us from the universal domination of quantum theory and allow us to examine this possibility". The key: "Just as the light in the Kappler experiment is not subject to the thermal fluctuations of the air and the mirror, perhaps gravity is not subject to quantum fluctuations".

Smolin had suggested that “the distinction between quantum fluctuations and real statistical fluctuations in the state of a system will not be maintained in a theory that gives a correct description of phenomena in which quantum and gravitational effects are both important”. Nelson assures us that “Stochastic mechanics has a natural derivation from the variational principle, and its predictions – which agree with the predictions of quantum mechanics – are confirmed by experiment. Had the Schroedinger equation been derived in this way before the invention of matrix mechanics, the history of the conceptual foundations of modern physics would have been different”. Although, by attempting to “provide a realistic, objective description of physical events in classical terms... Stochastic mechanics is quantum mechanics made difficult”. Already, Dankel’s work on the theory of spin in stochastic mechanics shows agreement with standard QM, and Pauli’s exclusion principle seems to follow from the fundamental assumptions of stochastic mechanics. Nelson’s “hunch is that no departure from the framework of stochastic mechanics is needed; that one needs to find the right classical configuration space and study ordinary diffusions, Wiener process plus a drift”. “The long range goal of the theory is the Einstein program of describing physical phenomena, including quantum effects, in terms of a classical field theory. Whether this is possible, no one knows. The success of stochastic mechanics show that, contrary to widespread belief among physicists, it is not obviously impossible”.

The closest analogy to our PL fluid was proposed by Assene Borissoff Datzeff and his **“subvac” (Substance de Vacuum)**, an Ether analog of sorts. His **AS particles (Atomes du Subvac)** closely parallel our PLs. According to Datzeff, ordinary particles are built up of AS corpuscles, and their dynamics create the oscillating fields of electric and magnetic fields. These oscillating fields create the “waves”, and their interactions with the formed particles produce motion, this motion being a “stochastic” process resulting from the multitude of AS corpuscles. Datzeff then derived the probability densities and differential equations of Schrodinger from this process.

Datzeff’s work was partly inspired by Bopp’s stroboscopic world-picture, where **the world is continuously created and annihilated** (a Heraclitean view - our PL continuous emergence from Non-Existence), as opposed to the permanence of matter advocated by classical theories. This in itself is consistent with QM theories of annihilation and creation operators. By seeing the particles as “ensemble” appearances in space, he could reconstruct the

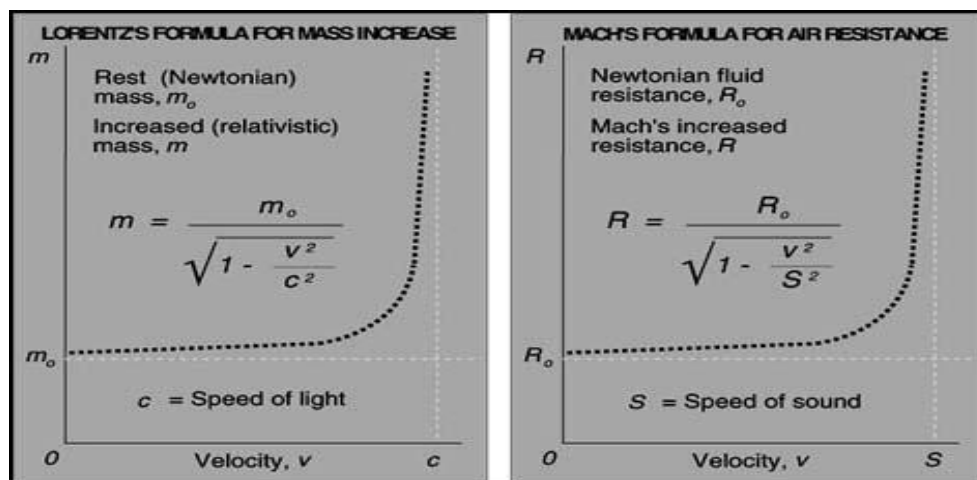
laws of QM using the laws of statistical mechanics, and concluding that while “particles” cause the events we see, the “waves” control the order of such events. Such ensemble descriptions avoid the difficulties of the EPR “paradox”, as Machado and Schutzer affirmed. Similarly, Lande’s “Unitary Particle Interpretation” takes a statistical ensemble description to recreate QM from non-quantal premises without the mystical particle-wave duality (mumbo – jumbo to many), a move applauded by Hermann Bondi. QM, if interpreted as a form of classical statistical mechanics, loses its mystery, and, to paraphrase Popper, “has nothing more mysterious in it than any classical theory of any game of chance”.

Other approaches to a Fluid Universe include Raphael Sorkin’s fluid lattice structures, providing a causal connection between space points. Ahmavaara prescribed a finite field with a discrete numerical structure. Stephen Dray suggests a field theory based on mathematical algebraic commutative and non-commutative properties that lead to an “emergent” quantum field theory. A similarly Mathematically-based model by Loll, Anbjorn and Jurkewicz uses geometric models in their CDT (Causal Dynamical Triangulation) model to reproduce spacetime effects – d-dimensional spacetime is formed by space slices labeled by a discrete time variable, connected by line segments that can represent either a space-like or a time-like extent, bringing in relativity with it, while preserving causality. Zeeya Marali, along with Xiao-Gang Wen & Michael Lavin describe the Universe as a String-Net Liquid, where “elementary particles are not fundamental building blocks of matter. Instead, they emerge from deeper structures of the non-empty vacuum of spacetime.” Others compare the quantized vortices in the superfluid to flux lines in superconductors, others to dark solitons in Bose-Einstein condensates. Thad Roberts compares the distortion effects in fluids of a moving body to its kinetic “mass” and energy when moving. A spinning superfluid breaks out into separate vortices, whose number is proportional to h/m , while the superfluid itself around them remains still.

All these models share a common element with our PL Fluid Universe. Bernard Sylvester’s twelfth Century chaotic “Hyle” (Cosmographia), a primeval and formless substance, out of which the elements are shaped and order is introduced, is reincarnated. Robert Grosseteste’s (*De Luce* and *De Motu corporali et Luce*) expanding primeval, transparent point of Light – Lux,

“the first form of a body”, “multiplies itself and expands”, creating our PL Fluid ocean.

“Modern theoretical physics ... has put our thinking about the essence of matter in a different context. It has taken our gaze from the visible—the particles—to the underlying entity, the field. The presence of matter is merely a disturbance of the perfect state of the field at that place; something accidental, one could almost say, merely a 'blemish'. Accordingly, there are no simple laws describing the forces between elementary particles ... Order and symmetry must be sought in the underlying field”. - Walter Thirring



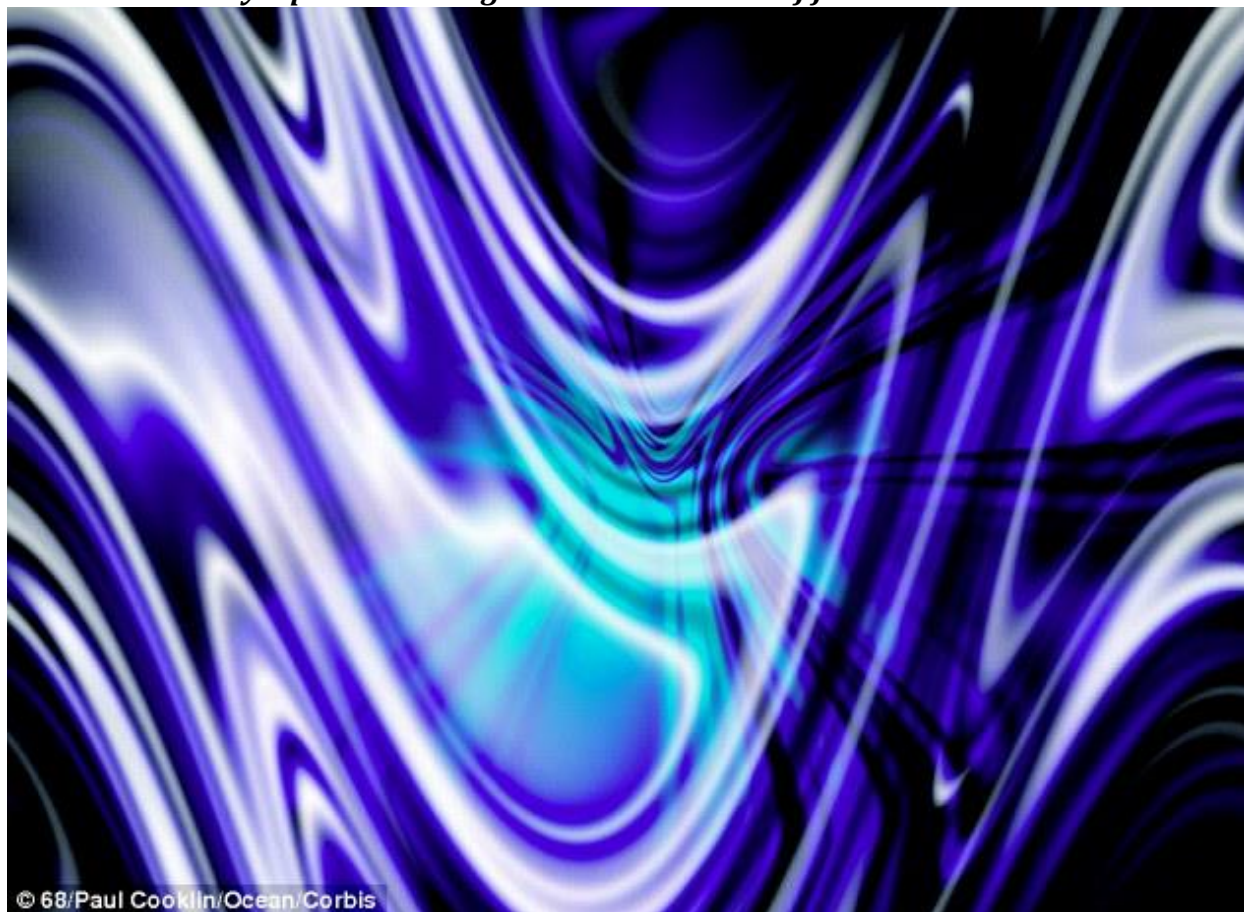
Mass increase and Mach Number (from Sorce Theory)

“Ch'i condensed in palpable matter was not particulate in any important sense, but individual objects acted and reacted with all other objects in the world ... in a wave-like or vibratory manner dependent, in the last resort, on the rhythmic alternation at all levels of the two fundamental forces, the yin and the yang. Individual objects thus had their intrinsic rhythms. And these were integrated ... into the general pattern of the harmony of the world.” - Joseph Needham, on Taoism

Takeaway: the PL soup represents a new Ether, resembling the Superfluids of our macroworld. Our laws (QM, Relativity, Standard Model) are emergent features of this Superfluid.

3.7.1 - SUPERFLUID VACUUM

“Black Holes, quarks, and gluons really do have a big thing in common: They can be described by equations that govern the behavior of fluids.” – Dam Thanh Son



The idea of a superfluid vacuum theory has been around for decades. The concept of a superfluid that provides a “medium” for the propagation of waves and photons, like sound in the air, sounds eerily close to the old discredited Ether. But with the advent of field theories, and our better understanding of the quantum world, they have been resurrected.

The idea of the Vacuum as a “Superfluid” of sorts has been gaining a growing acceptance in recent years. Sinha, Sivaram and Sundarshan had suggested that spacetime was a superfluid, a particle-anti-particle aether, macroscopically describable by the wave function, as early as 1975. This allowed a derivation of Schroedinger’s equation from first principle (which in its non-linear full form encodes a hidden (3+1) spacetime metric), and modeled gravity as a collective effect of superfluid fluctuations (foreshadowed by low-amplitude metric distortions arising from the Gross-Pittavaskii derivation of Bohm’s

equations). Barcelo, Liberati and Visser derived a model for analog gravity from Bose-Einstein condensates, and maintained that superfluidity leads to a general relativity framework. The great Sakharov himself had hinted that Gravity is no more fundamental than Fluid Dynamics.

Wilczek's "superconducting Grid" is another example. Tom van Flandern's "Meta Model" sees an Ether of tiny fast moving particles, providing a reference frame, Universal time (Simultaneity), and a determinisitic, causal world.

Liberati and Maccione have hypothesized this superfluid to have zero viscosity. Mazur and Chapline, studying its implications for Black holes, have found solutions that explain Relativity's breakdown in those domains. Their Super-Fluid Spacetime also has the negative pressure aspect that could explain Dark Energy (and also stabilizes the Black-hole into a "Gravastar").



Superfluid Vacuum Theory (SVT) is also known as BEC vacuum theory, where the superfluid is viewed as a Bose-Einstein Condensate. Dirac had hinted at this when he mentioned "the quantum fluctuations in the flow of the Ether". Sinha, Sivaram and Sundarshan suggested a model of a fluid of fermion – anti-

fermion pairs, a non-relativistic fluid that still produces particles obeying Lorentz Symmetry. Others, like Winterberg, suggested a fluid of planck mass plasma. All those theories suggest Lorentz Symmetry failing at high energies, while being maintained at low energy regimes. Mass generation (a-la-Higgs mechanism) is explained as due to the interaction with the vacuum condensate, similar to the gap-generation mechanism in superconductivity and the “photon mass” induced by the Meissner effect (and Nambu’s idea of broken chiral symmetry, where nucleons and anti-nucleons condense analogously to Superconductivity’s “Cooper Pairs”, as in pions).

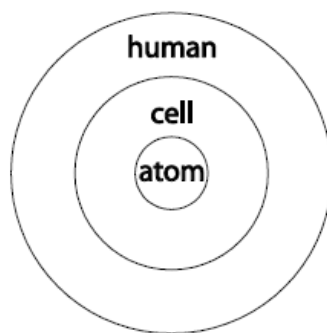
Thad Roberts’ Quantum Space Theory (QST) assumes a superfluid vacuum whose geometric structure resembles an acoustic metric based on a hierarchial fracta. The vacuum is constructed from quanta that are themselves constructed via self-similarity and scale invariance from other subquanta, ad infinitum. The resulting BEC provides the various SVT properties, where relativity and QM are emergent. Like our PL Fluid proposal, it places a premium on a visualizable, Ontological picture of the world. Time is similarly defined as the number of resonations of each quanta. Curved spacetime is also drawn by those quanta, and the discreteness restricts the range of curvature and helps control the infinities of GR. He even describes transference of energy from the quanta to the subquanta, leading to energy loss and impact on observed Red Shift, as in our PL picture. He also ties the Dark Matter Halos to existing matter clusters and their energies. His geometry (9 space dimensions and two time dimensions) also drives the characteristics of the four forces.

Roberts brings up the comparison with phonons, seeing the vacuum fluid made of interactive parts, and interactions driven by metric distortions in the vacuum substrate. The Casimir effect is also a result of field jitters of those “atoms” of space. Roberts’ view of dimensions is a stratified set of 3-dimensions each, the innermost being “intra-space quantum” space, the next being the mesh created by the space quanta (our normal x, y, z), and the highest being the inter-quanta “super-spatial”, although it is not clear how this last is quantized or continuous, and what composes it. Distance is also measured as the number of quanta of space traversed, as in our PL view.

This set of levels repeats indefinitely (an invitation to Occam, since no additional Physics is derived from it, but just the possibility of other worlds). The space Quanta in this sense is similar to the “Holons” of Sorce theory or

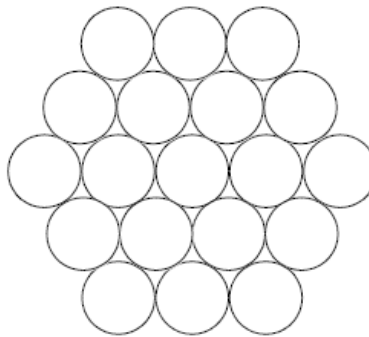
Spinbitz, being part and whole at the same time, infinitely divisible, while also being part of a large infinity – Cantor’s uncountable infinite and the cardinality of the transrational continuum. They exemplify “minimally complex” levels that “enfold” further complexity within them, holons embodying singularity and holarchy embodying multiplicity. Roberts’ view of additional dimensions similarly makes use of Depth versus Span, where depth within the quanta represents additional dimensions, and also emulates the quantized finite unit-spheres in the coordinates of the “transitive axis”.

DEPTH

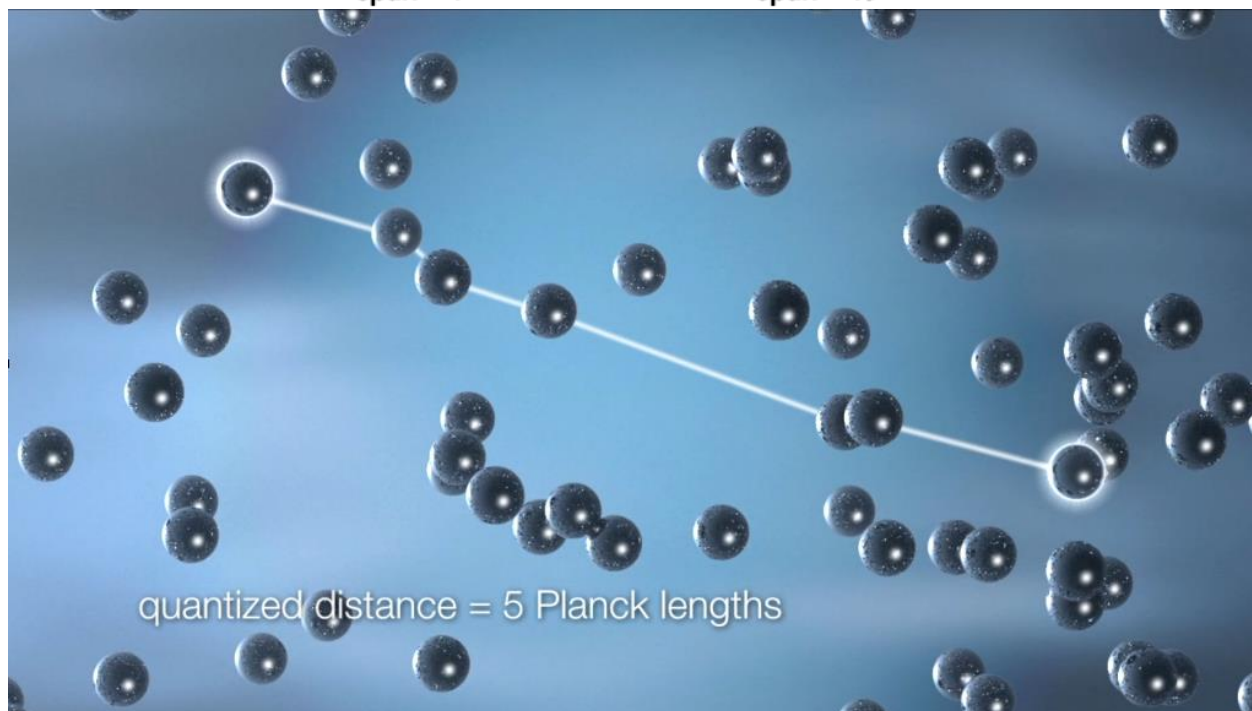


human:
depth = 3
span = 1

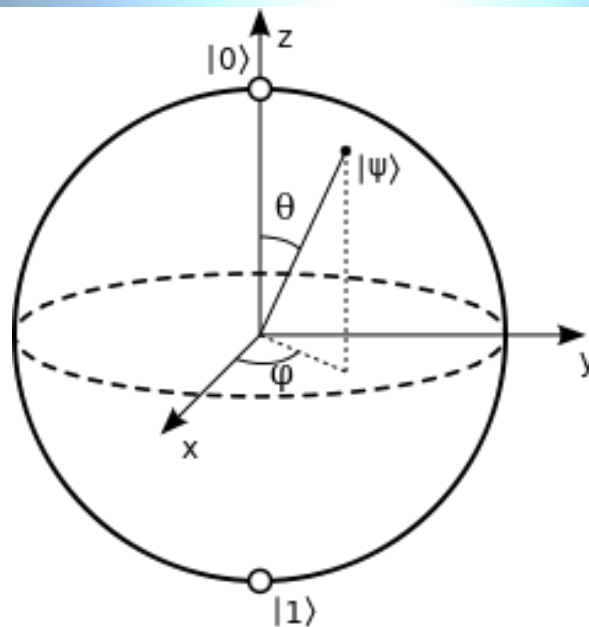
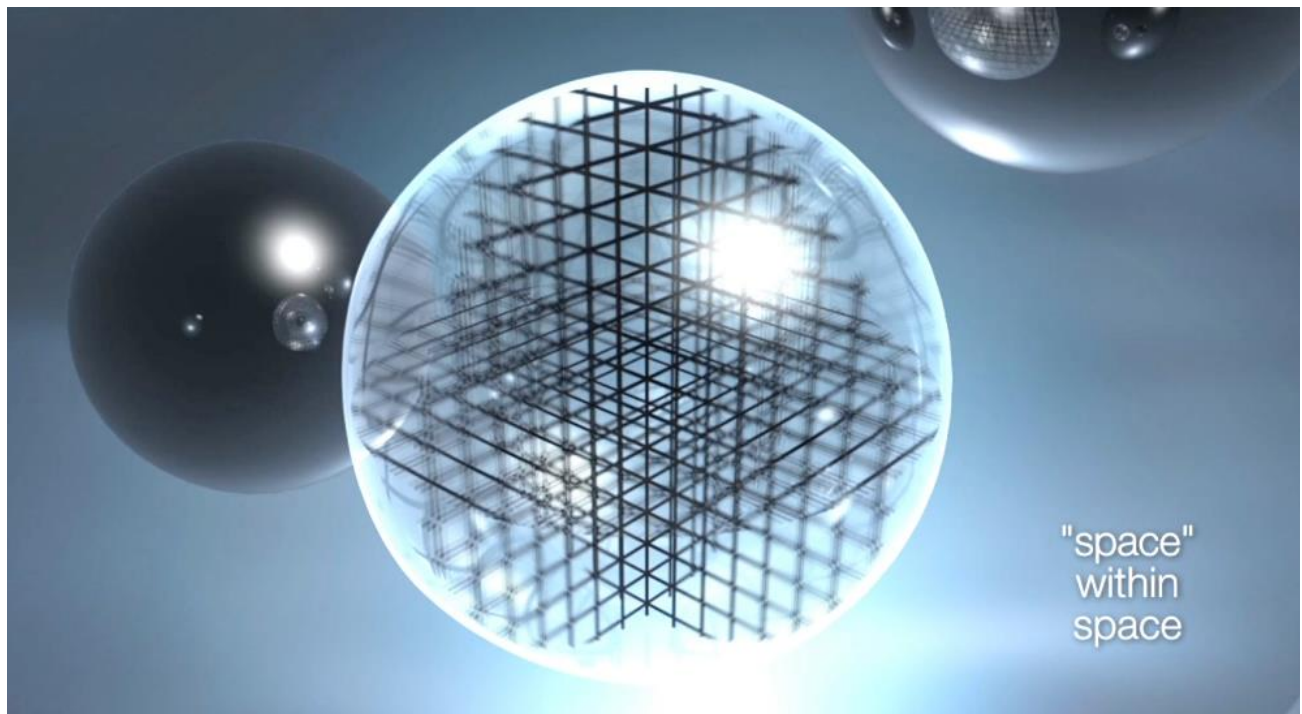
SPAN



atom:
depth = 1
span = 19

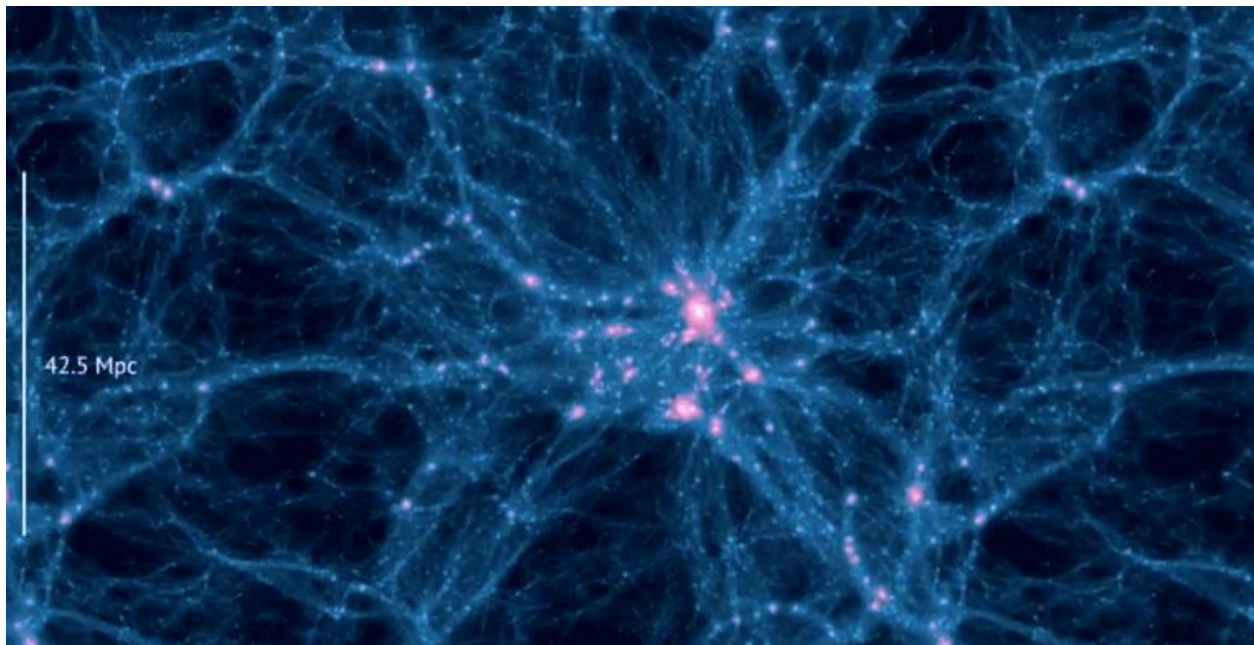


Many of the ideas of QST parallel our PL view, replacing the PL “logical” world in Hilbert Space with a quantum space element in a “superspatial” background.

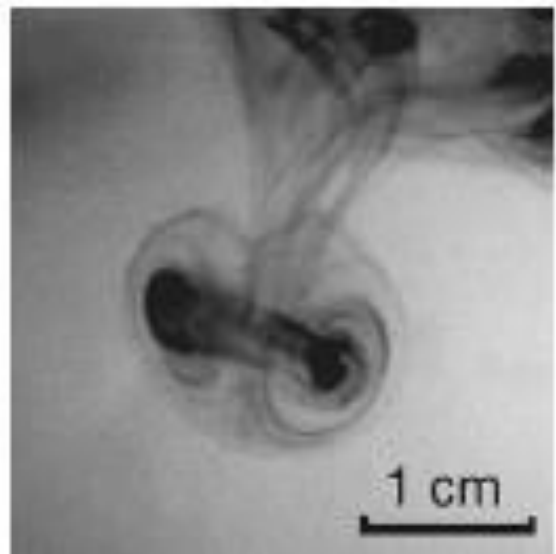
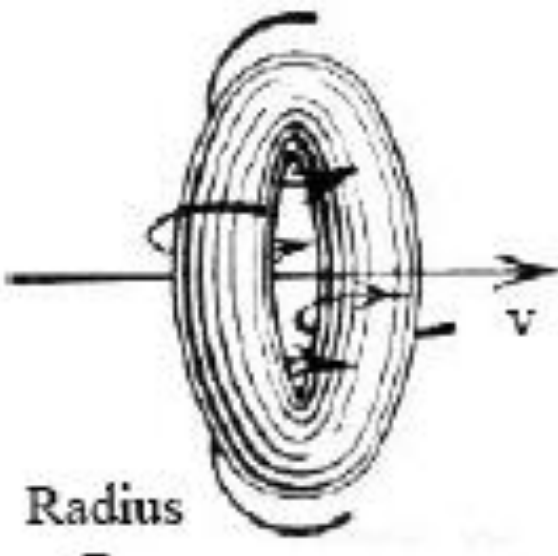


The dimensional view (especially the intra-quanta 3D mesh) parallels our multi-dimensional logical Hilbert dimensions, both ideas being a sort of a plot of those dimensions on a Bloch sphere. The limitation to three dimensions for this “inner” space seems unnecessary (even for visualization), since we know

the many dimensions needed for the EM, strong and other forces fields are mutually orthogonal (not necessarily in a 3D sense) and rotate by various symmetries into each other- hence a Bloch sphere dimensional image is more appropriate. For example, in our PL picture, PLs are not “somewhere” between the EM dimension and the Color dimensions- they do not take on multiple coordinate- they are in one or the other of the dimensions (i.e., their position matrix is a sparse one). Hence we can get orthogonality without the 3D picture.



Liquid Spacetime



Vortex Rings – Our electron- photonRings??

Those discrete quantum packets “shape” space, and the curvature of space simply depicts a change in the “amount of space” or change in the metric density, as in our PL construct. His quantum space density of “space atoms” changes, as does the density of Diamond and Graphite of carbon atoms, thereby changing the properties of space. He sees a distinct dimensional framework for those atoms, similar to our Hilbert Space, pointing to early phase transitions in the Universe and to the quantum Nature of Black Body Radiation as hints to the atomic nature of Space.

Roberts explains the “wave nature” of particles as the waves created by the particles in their disturbance of the qst mesh, with their interference effects explaining the double slit experiment, since they also act as guides for the particle path. One issue with the QST view is the idea of an infinitely layered set of dimensions, where each quanta has a universe within, megaverses floating among another sea of similar megaverses (akin to the billiard ball universes of “Men-in- Black”) , to which Roberts should apply Occam’s Razor.



The idea of a fractal Universe is fruitful, as we have seen in Nature's habit of repeating its tricks at all scales, but this is best used in our visible Universe and need not extend below the quantum level (the R , $1/R$ dualities of String theory can only be carried so far). The idea also that these layers lead to many universes has to deal with the overlapping impact of the upper layer on the lower layers, since the dimension sets work in sets of three. The insistence on a set of three dimensions for any "real" entity may be unnecessary, if one considers other ways of conceiving the independent dimensions in Hilbert Space. The Spinorial effects called for to explain Fermion effects (4π rotations, etc) can be seen dimensionally without requiring their dimensions to be "inside" the space quanta.

Roberts also explains the holographic principle, as well as the area dependence of entropy by their relation to the surface area of the space quanta, which are responsible for the interaction density. This may lead to circularity issues, with the definition of an "area" of a space quantum that is itself the measure of distance between clicks. The concept fails to turn the quanta into back-ground independent nodes, by assuming the super-space concept as a background, *ad infinitum*.

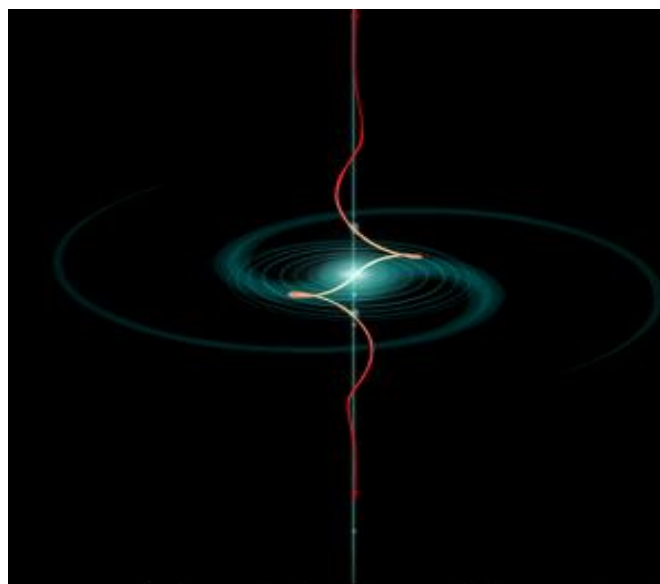
QST, working on ideas and recent observations by the likes of Pierre Sikivie, explains Dark Matter as a "phase change" in the vacuum, at the haloes of galaxies, where the "temperature" drops when far enough from the fire of the stars. The idea has merit, akin to the Dark soliton topological features of BECs, and is comparable to our PL "resonance" PL creation, as well as to Kerson Huang's scalar field. Matter generation is also related to quantum vortex formations in the superfluid vacuum & dark solitons in BECs, noting that Superfluid vortices are part of the solution of the non-linear Gross-Pitaevskii equation.

QST's explanation of Dark energy is more problematic. Like our PL view, which foresees a loss of energy for Light over cosmological distance due to pilot waves – partially offsetting expectations on recession speeds, QST sees a similar loss through dispersion effects and inelastic collisions between quantum levels as the ONLY source of the Redshift in far Galaxies, thereby rejecting the concept of Dark Energy completely. The problem with this is that (aside from the unclear mechanism of transfer between quantum levels) this idea negates the explanation of space expansion in the first place (after the Big

Bang) even without the effect of Dark Energy, and also fails to explain the shift between mass dominated expansion to energy dominated expansion leading to acceleration. The explanation also of the energy drop by relating it to acoustic wave drop with temperature of the vacuum, would also mean light speed would also be dropping with the lower temperature. Seeing expanding space as just a “thinning out” of space quanta conflicts with the relational definition of distance as the number of quanta jumps adopted by QST (as in our PL picture), in which space can only grow by growing more nodes.

Lorentz contraction effects, as well as inertia, are attributed to the space quanta being pressured by the fast moving body as it approached the Mach-1 limit of the Ether environment (the speed of light in this case, c), similar to air drag effects and pressure waves in air, something also pointed out in Sorce theory, with the increased density also affecting the rate of change of time. Lebau’s “Abquom” (Absolute Quantity of Motion) changes with the density of space, being higher for higher densities (more nodes crossed per “standard” interval due to more matter nodes).

The QST view, while close in concept to the PL view, leaves unexplained the “background” superspatial dimensions, which is not quantized, and does not have clear constituents (reminiscent of Quantum Theory and String Theory’s background dependence). Those ideas recall Al-Razi’s ideas about dual definitions of relative and absolute space, and relative and absolute time. The PL view avoids this by a single logical quantum view, that does not require “material” quanta and a superspatial background, or a super-time dimension.



Kerson Huang describes a superfluid Universe model that sees the density of the superfluid as the Dark Energy, with the Dark Matter halos around Galaxies as areas of higher Superfluid densities. Quantized Vortices are flows around a line (the vortex line), whose phase changes in multiple of 2π , making them identical. Vortex reconnections provide an efficient way to convert large amounts of potential energy into kinetic energy, providing for the creation of jets of matter – a process analogous to the solar flares generated by the reconnections of solar magnetic flux lines.

It is easy to conclude from many of the emerging proposals that the Ether is a dynamic Fluid. It is the same as the quantum vacuum – the Ether of the 21st Century, based on what we have learnt since the quantum revolution of the 20th Century, which had shed many of the 19th Century views without providing a plausible “picture” to replace it. The current trend in Standard Model research is to view this new Ether as a “zero-energy SuperFluid” or a quantum Liquid. When studying the properties of 3He-A superfluid at low temperatures, it almost seems like the atoms are “just going along for the ride” embedded in the frictionless dynamics of the “zero-energy superfluid quantum vacuum” (Morrison), with the critical difference between superfluidity and the quantum vacuum being the symmetry-breaking effects of the atoms.

Recent experiments support this view. Alan Krisch’s experiments with spin-aligned protons seem to imply they are actually some form of a vortex, like a plasmoid, which interact strongly when spinning in the same direction at high energies. The “Handedness” of particles also simulated the typical orientation of a vortex, with opposite-handed vortices annihilating each other when they clash, as particles and anti-particles do.

Eric Lerner says: “... since the nineteenth century it’s been recognized that the equations of electromagnetism are almost identical with the equations of hydrodynamics, the equations governing Fluid flow. Even more curious, Schroedinger’s equation, the basic equation of quantum mechanics, is also closely related to equations of fluid flow. Since 1954 many scientists have shown that a particle moving under the influence of random impacts from irregularities in a fluid will obey Schroedinger’s equation.”

“More recently, in the late seventies, researchers found another curious correspondence while developing mathematical laws that govern the motion

of line vortices – the hydrodynamic analogs of the plasma filaments and Z-Pinch effects ... The governing equation turns out to be a modified form of Schroedinger's equation, called the non-linear Schroedinger equation. Generally in Science when two different phenomena obey the same or very similar mathematical laws, it means that in all probability they are somehow related. Thus it seems likely that both electromagnetism and quantum phenomena generally may be connected to some sort of hydrodynamics on a microscopic level." Particles are not fundamental, but have an internal structure, which the probabilistic wave equations describe- the probability and Heisenberg's uncertainty relations coming from the ignorance of this structure.

"If Superfluids are set into rotation, their motion is quantized, and they form quantized vortex filaments and vortex rings that behave remarkably like fermions and bosons respectively" (Peacock). While the equations that govern such processes are complicated, and even numerical simulations are difficult, the topological approach is straight-forward, and many such complicated phenomena can be seen as what they really are: topological structures and defects, and we can therefore predict much of their behavior without knowing the details of the underlying structure. An apt analogy is Bohr & Wheeler's water-drop model of the atomic nucleus, which explained & approximated much of nuclear physics while ignoring the underlying scheme – very appropriate for our situation given the fluid model approach.

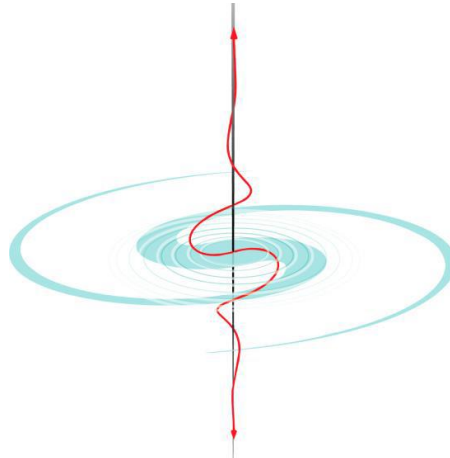
Our PL Fluid Universe picture fits well within these various SVT models, postulating a Digital PL Superfluid. By defining the PL as a "logical" entity, it removes the need to explain "substance". More Mass thereby becomes More Math, creating a virtual Universe that is at the same time real to those entities residing within it. This Digital, Logical Universe is created by a Digital Fluid of Pls, set into motion by simple rules, whose fractal effects create the complete Symphony around us. If an advanced civilization or being wanted to create a Universe, here is one way to do it. Our Universe thus created would be undistinguishable from a "real" Universe, perhaps because the "real" Universe is thus constructed.

The PL picture is the simplest starting point, that does not require "pieces" of spacetime or energy or beginning constructs, except the logic of existence emerging from the undetermined chaos. Like LeBon's primordial ether,

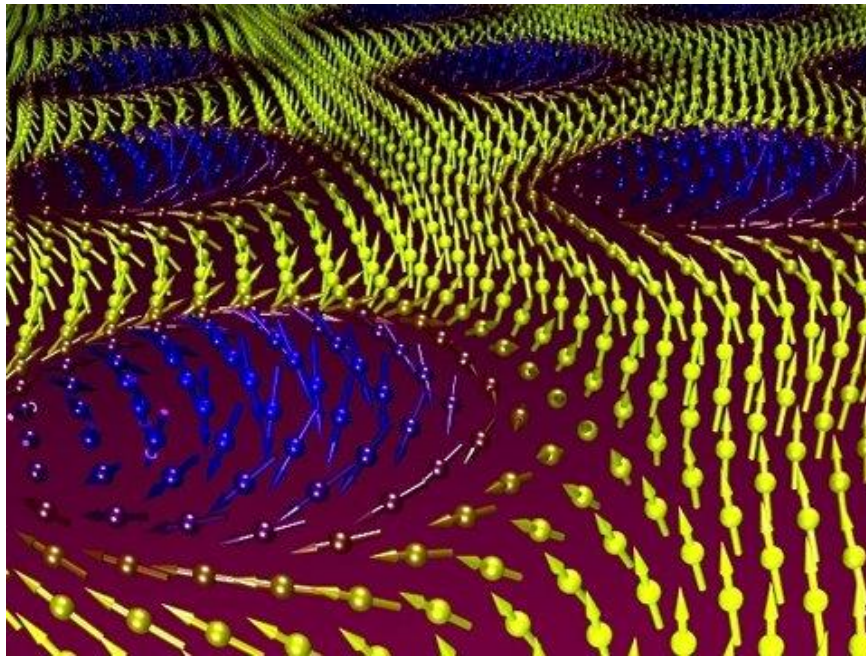
starting with a 'shapeless cloud of ether', this primitive fluid is organized into energy packets and matter. Once created, its interactions do the rest.

"The Universe as a whole acts somewhat like a gas."

- Neil DeGrasse Tyson



"All is Flux" - Heraclitus



Takeaway: The modern Vacuum is a superfluid of PLs.

3.7.2 - SIMULATED UNIVERSE

As Volovik highlights in detail, “in the extreme limit of low energy the condensed matter system of special universality class acquires all the symmetries, which we know today in high energy physics: Lorentz invariance, gauge invariance, general covariance, etc.”, i.e. it simulates our Universe. He shows how Helium 3 simulates fermionic and bosonic collective modes, including chiral fermions, and induces metrics of the space with the “quasi-particles” moving along the geodesics. This “conceptual similarity between condensed matter and quantum vacuum allows us to simulate many phenomena in high energy physics and cosmology, including axial anomaly, baryoproduction and magnetogenesis, event horizon and Hawking radiation, cosmological constant and rotating vacuum, etc., probing these phenomena in ultra-low-temperature superfluid helium, atomic Bose condensates and superconductors.” (Volovik). Those conclusions have been substantiated in many He3 and He4 Superfluid experiments.

Nature is giving us hints again. The Macro Superfluids we have (like He3) provide many analogies, that can teach us about the ultimate superfluid that our PL sea is. Experiments with spin ices (dysprosium titanate) simulate magnetic monopoles, which we have not seen in Nature yet. The effective magnetic monopole “quasi-particles” they create are phenomena mathematically analogous to magnetic monopoles, including interwoven tube-like bundles resembling Dirac Strings. The B^* field in superfluids related to superfluid vorticity is mathematically analogous to the magnetic B - field, and is even called a “synthetic magnetic field”. Experiments with Bose Einstein condensates were able to create monopole quasi-particles in the B^* field. The properties of these “quasi” particles are emergent from more basic properties of their underlying physics and structure, and the same should apply to the particles emerging from the PL superfluid, if we apply the similarities and lessons learnt. They could also serve as modeling tools to confirm the mathematical ideas.

Experiments with He3 (fermionic) superfluids and He4 (Bosonic) superfluids (Volovik) are especially instructive. They emulate the GUT regime at low energies/temperatures, highlighting the breaking of symmetries. More importantly, they show that high energy regimes require a new way of thinking that must take into account the “microscopic” planck-scale

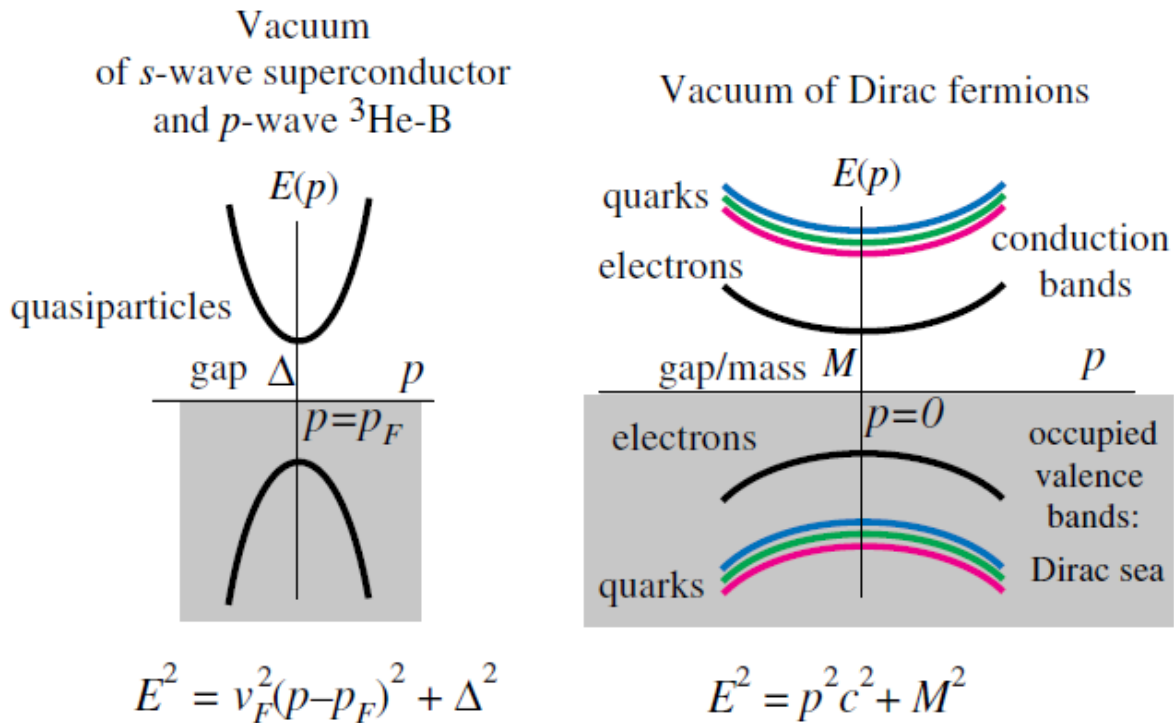
“particles”, as opposed to the macro particle quantum rules. Our PLs become critical in this range – hence the disconnect between quantum calculations of Dark Energy assuming the usual quantum fields. It also shows that the microscopic planckian regime provides the “constants” of nature, such as the speed of light (equivalent to the speed of sound in He3), modulus of elasticity, superfluid density, etc.

By studying the phonons and rotons in He3/4 superfluids, we are getting a view of the behavior of photons in the PL superfluid (including showing that the “zero-energy” calculation rules for dark energy give the wrong result.). It shows that the quantization rules do not apply at the PL scale, and as such the “grand unification” scheme must be addressed differently at high energies and planck scales, and that QM as well gravitation, gauge fields, etc, are relatively low energy constructs in our era, and will not help unify the picture at Big Bang energies. The “Planck” condensed matter superfluid exhibits a huge set of degrees of freedom at the planck scale, and hence those “low energy” modes merge with them. Gravity being an effective field in the low energy regime, will not yield to quantization. Gravitation in the superfluid is represented by inhomogeneity of the flow, impacting the motion of Bosonic and fermionic “quasi-particles”.

Again, Hydrodynamics (such as proposed by Landau and Khalatnikov) provides a key insight, providing an “effective field” simulating a gravitational field and its excitations (matter- quasi-particles in this case), with phonons playing the role of gravitons. In the He3 or He4 superfluid, the “microscopic” particles are the individual atoms. In the cosmic superfluid, the “microscopic” particles are the PLs. The macroscopic “quasi-particles” of the He3/4 superfluid are the excitations that form the “viscous” normal components of those fluids, whereas “matter” in the cosmic superfluid similarly represents the excitations that form the “inertial” component of that fluid, and which hold the thermal and kinetic properties of that fluid. The “rotons” of the He4 superfluid do not yield to the effective field analysis, and they correspond to the high energy spectrum in nature, which requires a “micro-scopic” PL level analysis.

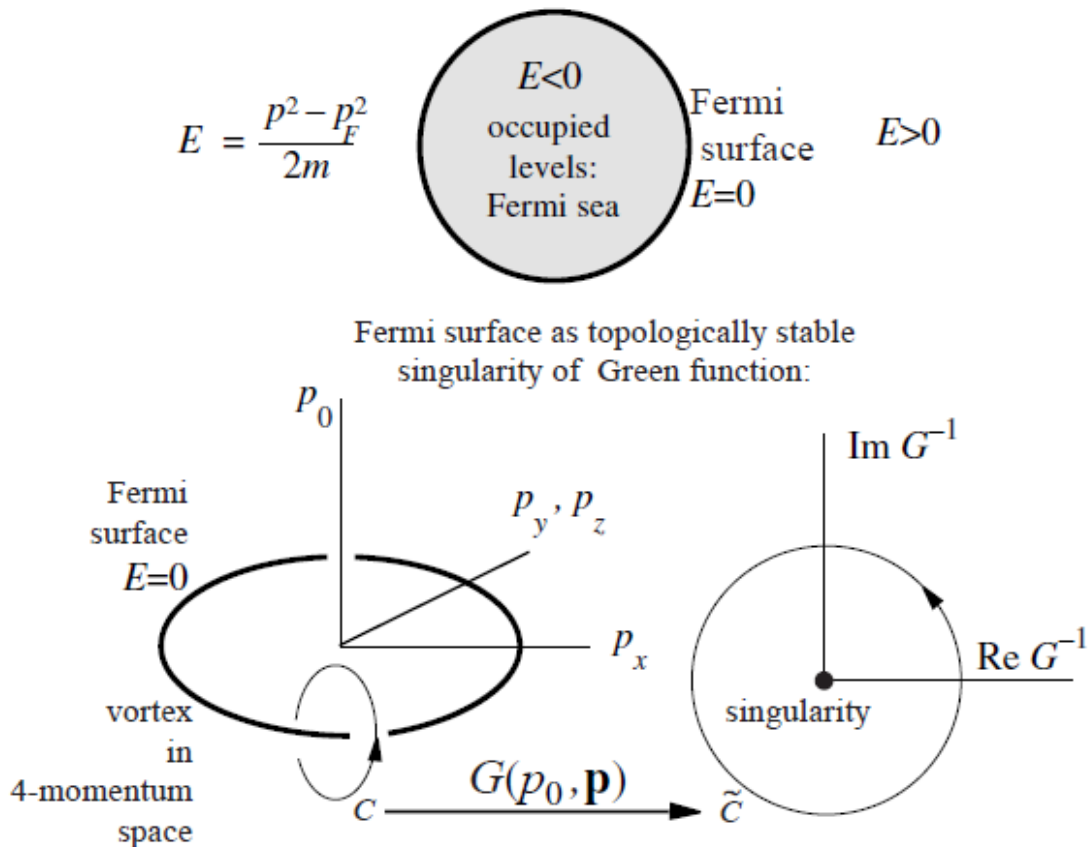
An Unruh sonic black hole in the superfluid simulates a gravitational black hole, with the relaxation of the superflow in the presence of the horizon emulating

Hawking radiation (the Zel'dovich-Starobinsky effect) for the relaxation of a black hole.



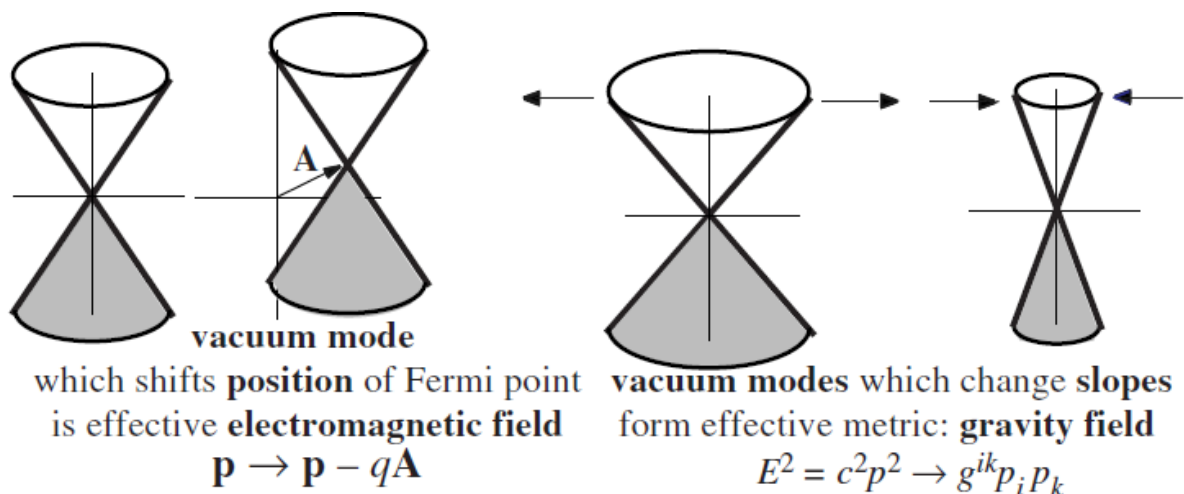
The microscopic model in He4 provides a “vacuum energy” equivalent and a pressure comparable to what we measure in cosmological scales, namely a vacuum energy density of zero, with the simple assumption that the physical vacuum is a liquid self-sustaining system. This conclusion is independent of the details of the microscopic system. This equilibrium ‘Vacuum’ energy does not gravitate, and hence our proposal that the flat PL mesh expands Space into a flat background, which is what is observed. Gravity is “the low frequency...classical output of all the quantum degrees of freedom of the “Planck Condensed matter”. So one should not quantize the gravity again...” (Volovik). The “vacuum” (superfluid) pressure compensates the “matter” (quasi-particles) pressure, emulating a very small cosmological constant, without the need for fine tuning. This does not come out naturally from the effective theories (GR and QM), but it follows from the more fundamental planckian level. Momentum and energy transfer between the “quasi-particles” and the superfluid emulate the exchange of momentum and energy between matter and the gravitational field. The particles themselves are seen as vortices in momentum- frequency space, being topologically stable Fermi surfaces in the Fermi liquid, whose “winding numbers” provide the

quantization (including winding $\frac{1}{2}$ Alice Strings) (also simulating their spinon, orbiton, and holon components). The creation of quasiparticles in moving He3-B at the Landau velocity is similar to the creation of electron-positron pairs by strong EM fields. (“In quantum liquids the Fermi points always appear in pairs, so that the sum of topological charges ... of all the Fermi points is zero. ... The emerging physics is natural because vacua with Fermi points are natural: they are topologically protected. If a pair of Fermi points with opposite topological charges exist, it is difficult to destroy them because of their topological stability: the only way is to annihilate the points with opposite charges” (Volovik)). One can see particle stability, anti-matter, and charge properties emerge.



“The correspondence between field theory and 3He-A is achieved by replacing the gauge field and the metric by appropriate 3He-A observables”. The Bogoliubov spin responsible for chirality in He3 plays the role of spin in chiral fermions in the Standard Model. The formation of mass is similarly described as the favourable energy (decrease in vacuum energy) of quasiparticles, similar to quark mass generation from their condensate. Near the He3 Fermi

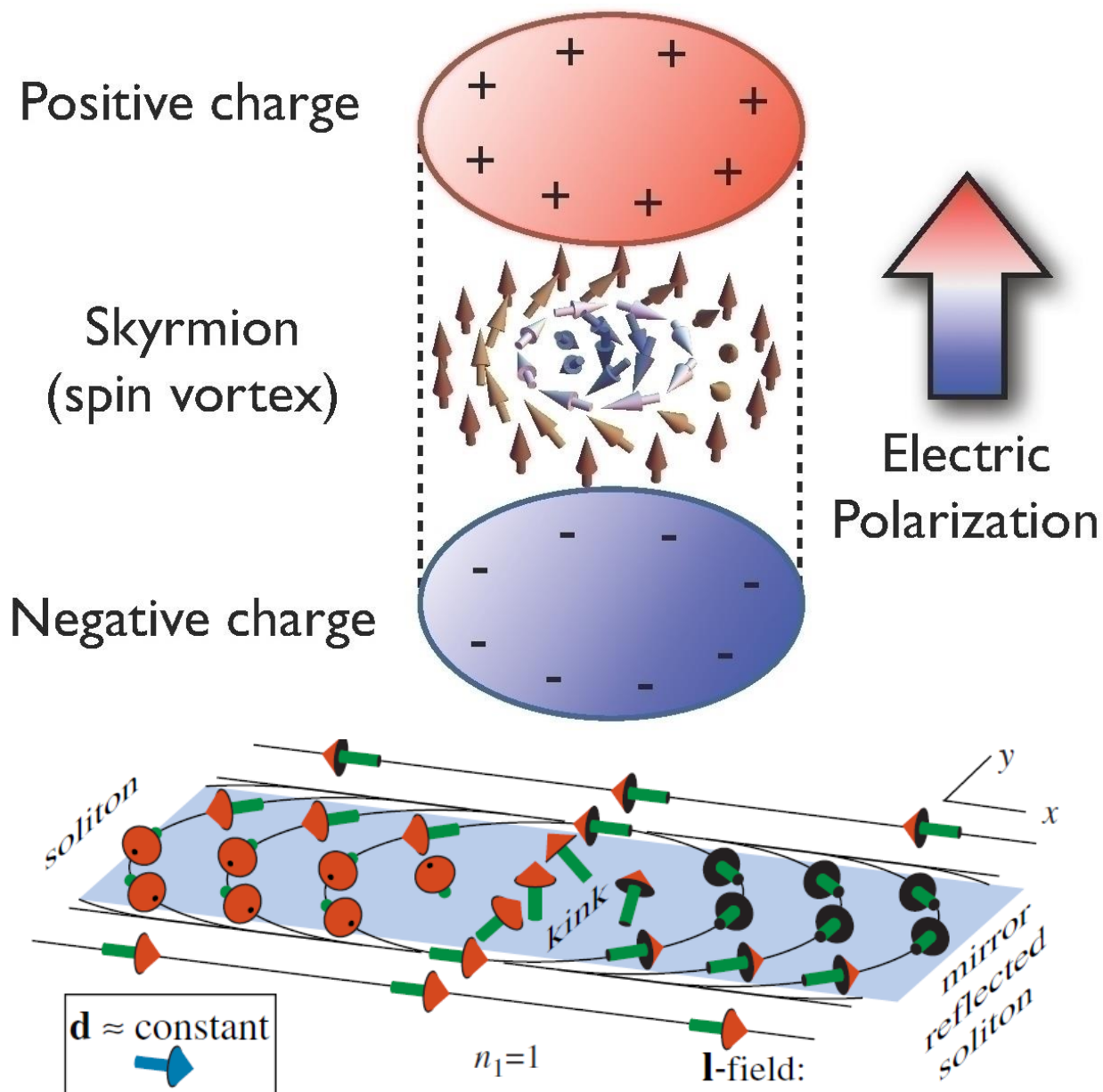
point, physical laws such as Lorenz invariance, gauge invariance, general covariance and conformal invariance are respected. A quasi-particle looks like a fermion moving in the effective dynamical EM and Gravitational field. The Iodarnskii force is the analogue of the Gravitational Bohm-Aharonov effect. Vierbein walls become domain walls in He3-A, with their possibility of superluminal connections in Planck scale energies. Propagating oscillations are seen as bosons or electromagnetic waves. A similar energy scale hierarchy is present, emulating the energy scales of the force unifications, with the planckian scale interestingly showing Lorentzian symmetry disappearing. Families of Fermions also appear. “The reason why all the attributes of the relativistic quantum field theory arise from nothing in 3He-A is that both systems, the Standard Model and 3He-A, have the same topology in momentum space” (Volovik). It seems that the low-energy properties of different vacua are robust, not depending much on the microscopic details of the substances, but rather more on the underlying symmetries and topologies present. The microscopic details provide only the ‘fundamental constants’ like c , modulus of elasticity, etc, which can be rescaled without affecting the fundamental behavior of the systems, as long as the symmetries and topologies are similar.



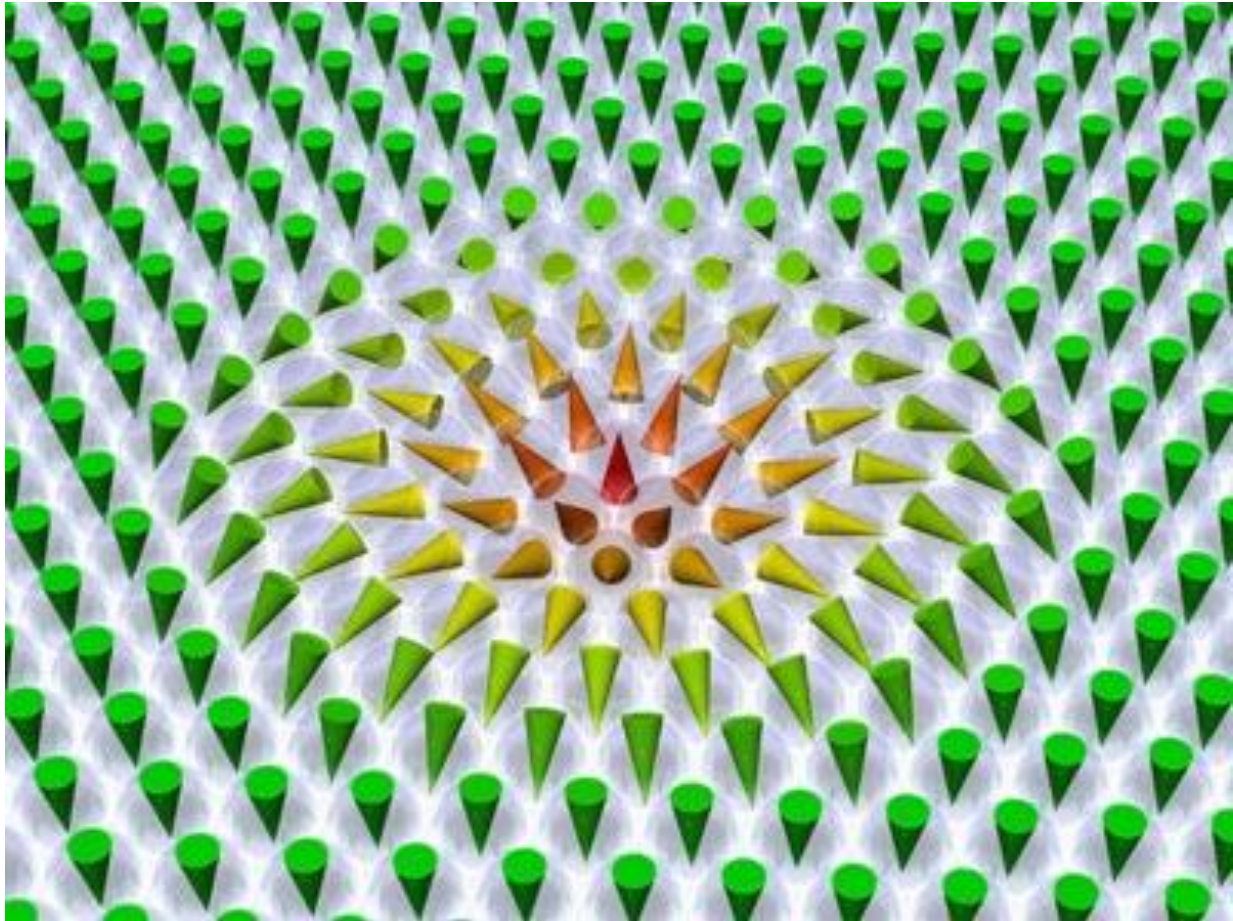
Quasiparticle near Fermi point is left- or right-handed particle moving in effective gravitational, electromagnetic and weak fields

$$g^{\mu\nu} (p_\mu - qA_\mu - q\tau \cdot \mathbf{W}_\mu) (p_\nu - qA_\nu - q\tau \cdot \mathbf{W}_\mu) = 0$$

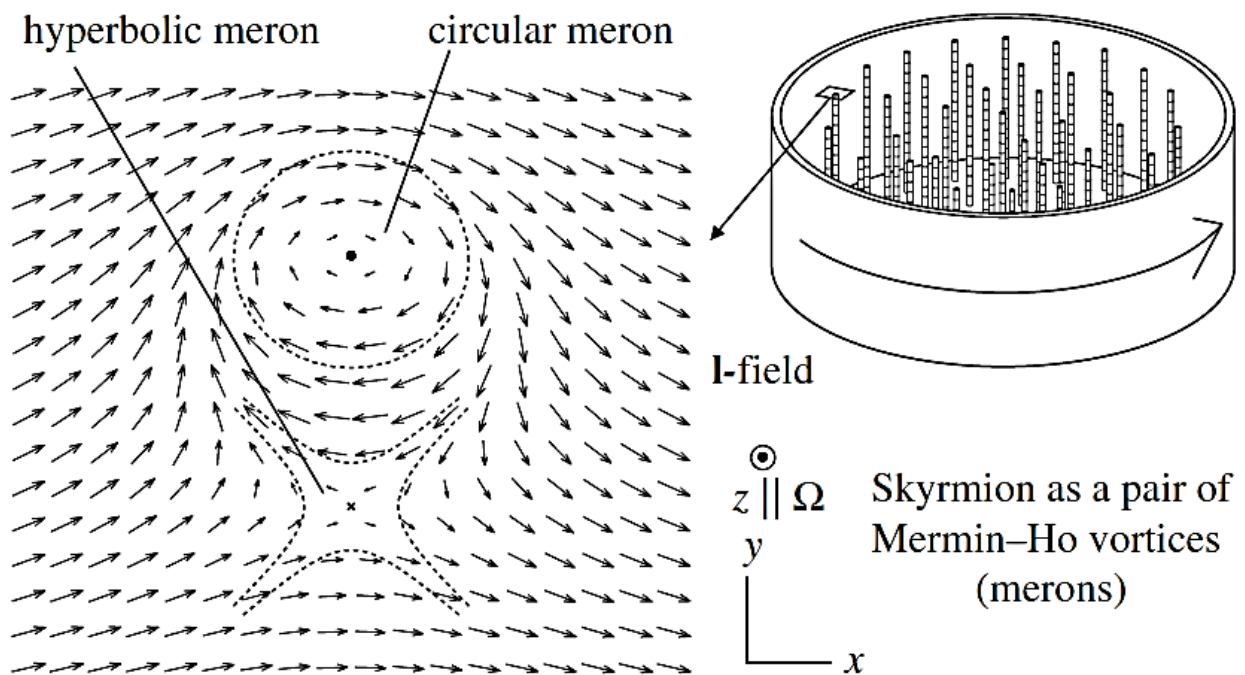
The physics and topology of Merons and Skyrmions sheds a light on how particle configurations could come about, through vortices forming in a superfluid. From Merons forming on Soliton sheets, to Skyrmions used in Spintronics, you can visually see particle formations from a digital whirling fluid. Skyrmions have been proposed as models for nucleons (Skyrme), and Merons suggested to produce color confinement in QCD (Steel and Negele). These structures are easily duplicated in a Helium superfluid.



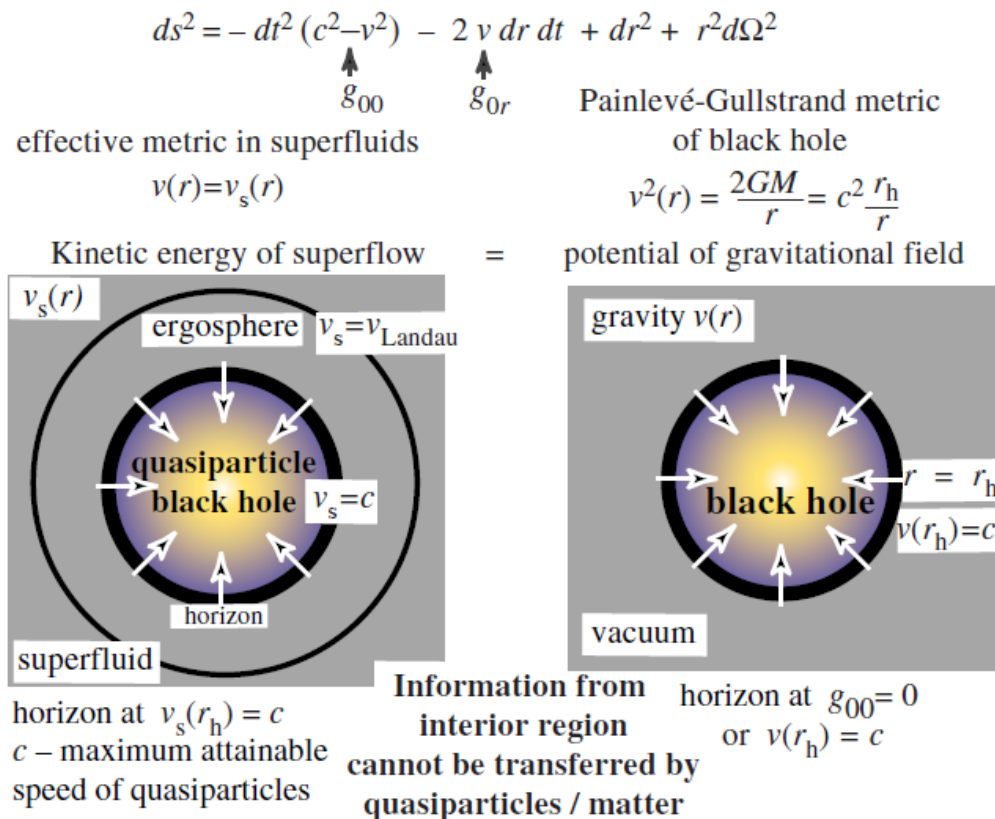
Alternating merons – circular and hyperbolic Mermin–Ho vortices form the vortex sheet in $^3\text{He} - \text{A}$



Skyrmion - from a whirling Vortex



The study of Superfluid physics seems an imperative to understand the overall structure of the Universe. Many phenomena seen in Superfluidity may be waiting for us to see their analogs in the universal vacuum. Based on experimental and theoretical data, it seems that the first intuitions of our 19th Century giants of Ether and vortices are being vindicated. A picture where we replace He3 with our PLs would lead to a visualizable Ether, with experimental simulation now at hand. Formation of Cosmic Strings in an expanding Universe via the Kibble mechanism are simulated by vortex nucleation in the non-equilibrium phase transition. Simulations of the possible temperature dependence of the gravitational constant during cosmic evolution can be studied, as Dirac had conjectured. In fact, even “Big-Bang” simulations become possible (and have been effected using thermal neutrons to create the equivalent of the “primordial fireball” in the He3 superfluid). “This makes the superfluid 3He a working laboratory for modeling different processes which can occur in the physical vacuum and in Universe” (Volovik). Wilczek and others have already noted the similarity of color superconductivity in quark matter to the effect of superconductors on photons, and the symmetry breaking schemes in Superfluids.



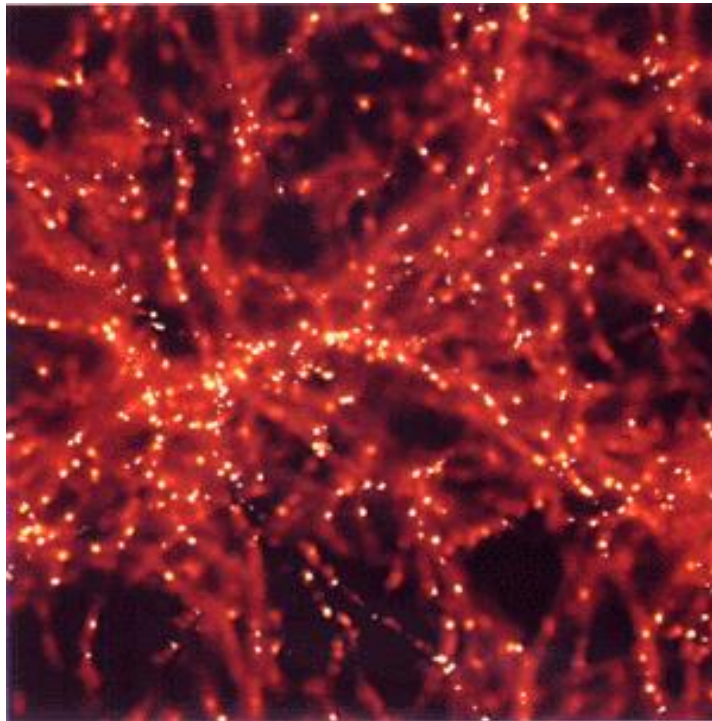
Unruh Sonic Black Hole

The results so far from He3 and He4 simulations support some of our suggestions on what Volovik calls “anti-grand-unification” concepts, where chirality, fermions, gauge fields and gravity emerge in the low energy domain, where QM, the Standard Model, Lorenz Symmetry and SU(N) symmetries arise as effective theories (Polyakov, Weinberg, Jegerlehner). On the other hand, “high Energy” domains (better called planckian-scale domains, because that does NOT necessarily mean high-energy in our proposal) do not obey these symmetries and rules (Froggatt & Nielsen, Chada & Nielsen), and hence the disconnect in QM’s calculation of vacuum energy, and the mysteries of entanglement and superluminal communication. “Grand Unification schemes make no sense if the unification occurs at energies where the effective theories are no longer valid” (Volovik). At the same time, the results from the effective theories (phonons, gravity, etc.) will not tell us much directly about the ‘microscopic’ structure of the vacuum (Hu; Padmanabhan; Laughlin & Pines). The study of superfluids, however, can help us simulate those effective theories, and also tell us what features are or are not dependent on the planck scale details. Nelson calls for such systems with large “effective Planck’s constant” to simulate fluctuations predicted by stochastic mechanics.

Helmholtz’s and Kelvin’s vortices in the ether are revived. The Kelvin-Helmholtz instabilities of the ether create the vortices and waves, which simulate our matter world. A self-sustaining quantum vacuum, whose energy is non-gravitating, supplies our Dark Energy, matching observation and solving the quantum vacuum energy discrepancy. A quantum vacuum whose low-energy manifestations provide the “effective” theories of gravitation, Standard Model, and our known science.

The field owes a significant debt to Landau and the Landau school in Russia, especially Zeldovich, Khalatinov, & Starobinsky. Volovik seems to be the current standard bearer. Zel’dovich in particular had looked for many similarities between cosmic structures and common experiences, seeing the world as a macrocosm in a microcosm, “To **see a World** in a Grain of **Sand**, And a Heaven in a Wild Flower, Hold Infinity in the palm of your hand And Eternity in an hour” (William Blake). One example: the formation of high density regions in the universe resembles the formation of caustics in Light (where light passing through water or glass intersects trajectories forming bright spots). Such ‘Caricatures’ and analogies are informative and intuitive-also potentially misleading, but always worth pursuing. The message: Keep

your eyes, and mind, open, for Nature always speaks to us, if only we would listen.



Universe



Caustics

Takeaway: The He3 superfluids can be used to simulate the Vacuum, and its emergent features.

3.7.3 - ETHER REDUX

“We of the present generation are impatient to wait for anything. Within thirty years of Michelson’s failure to detect the expected motion of the earth with respect to the ether we have wiped out the slate, made a postulate that by no means whatever can the thing be done, and constructed a non-newtonian mechanics to fit the postulate. The success which has been attained is a marvelous tribute to our intellectual activity and our ingenuity, but I am not so sure with respect to our judgement.”

- Max Born, Einstein’s Relativity - 1962

Einstein himself denied being aware of those 1887 Michelson-Morley experiments when he made his Special Theory of Relativity. He had not “banished” the Ether – he just didn’t need it for his thought experiments. He later reconfirmed his belief in a kind of Ether as necessary for his General Relativity.

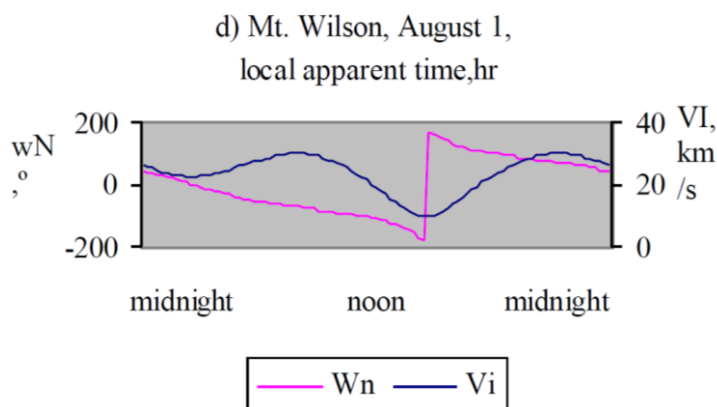
Experiments by Dayton Miller had conflicted with M&M’s results, something that had worried Einstein. Miller’s work (done partially with Morley) , done over a 20 year period through the 1930’s, supports the idea of an Ether drift through a cosmological medium – a drift at 10 km/sec (versus the “speed” of earth at 208km/sec against the galactic background), implying an Ether “flowing” with the earth to a large degree. Variations of the tests (like some in thick-walled enclosures) confirmed this assumption. Vigier and Sagnac suggested positive ether drift is compatible with special relativity if photons are assumed to have a very small mass, something that also would explain “tired light” effects on redshift (see our later discussion). The idea of light having a very small mass was mentioned by Einstein and De Broglie.

More recently, a re-analysis of the M&M data (as well as Miller’s data, Illingworth’s Helium data, among others) by Munera has shown a small but significant effect (including diurnal variations) after allowing for several systematic errors (including the slower speed of light in Air and Helium) in the original analysis, confirming their “compatibility with absolute space” and their correspondence with data from COBE measurements and CBR observations. His analysis of Miller’s and Illingworth’s sessions “found that in both cases the measured speeds exactly correspond to the projection of earth’s orbital velocity only. As a result, the evidence against a preferred frame completely disappears”. After reviewing all other recent M&M type experimental results, interpreted in light of corrections to their methodology,

Munera concludes a “consistency between observation and absolute space”. Roberts challenges the measurements results, and the issue seems to be an open subject of fine experimental and statistical details. Its resolution will not affect the arguments for the validity of an Ether model, since the un-observability of the Ether is an essential common-point of Lorenzian and Special Relativity.

		Bounds 95 % C.L.	
Date	VI, km/s [7]	Lower, km/s	Upper, km/s
April 01/25	10.1	9.1	11.1
Aug.01/25	11.2	10.2	12.2
Sept. 15/25	9.6	8.6	10.6
Feb. 08/26	9.3	8.3	10.3

Miller Measurements at Mt Wilson



The problem everybody had with the Ether is the idea of a “solid Ether”. When it came out that light is a transverse wave, and not longitudinal, and since it was assumed such waves cannot travel in liquids or gases, but only in solids, the “solid-Ether” was born. This despite Maxwell formulating his laws with an analogy to incompressible fluid flows, and Lord Kelvin’s demonstration that “vortex-saturated” regions of a fluid supported transverse (shear) waves. What M&M had disproved was this solid-Ether hypothesis. But Einstein saw through this eventually: what M&M had proved was not that the Ether did not exist, but that it was Dynamic:

“It may be added that the whole change in the conception of the Ether which the special theory of relativity brought about, consisted in taking away from the Ether its last mechanical quality, namely its immobility.

What is fundamentally new in the Ether of the general theory of relativity as opposed to the Ether of Lorentz consists in this, that the state of the former is at every place determined by connections with the matter and the state of the Ether in neighbouring places, which are amenable to law in the form of differential equations.

According to the general theory of relativity space without Ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring rods and clocks), nor therefore any space-time intervals in the physical sense. But this Ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time.

The idea of motion may not be applied to it.”

He later identified the ether with the gravitational field, and summarized: “the ether of the general theory of relativity is a medium without kinematic and dynamic qualities, but which codetermines mechanical and electromagnetic events”.

Michelson confirmed this: “The interpretation of these results is that there is no displacement of the interference bands. ... The result of the hypothesis of a **stationary** ether is thus shown to be incorrect.” The “Ether”, tied to the Earth’s Gravitational field, moves with the earth. In fact, since the Earth rotates with respect to its own gravity field, rotation effects can be observed, as was confirmed in the Sagnac Effect, and in the Michelson-Gale experiments in 1925 using the actual rotation of the Earth to rotate the M&M interferometer. Sagnac’s “On the Proof of the reality of the luminiferous ether with the rotating interferometer experiment” was ignored by the mainstream, Langevin’s belated attempt at explanation using Galilean kinematics, while Hasselbach and Nicklaus saw the “great variety (if not disparity) in the derivation of the Sagnac phase shift constitutes one of the several controversies... that have been surrounding the Sagnac effect since the earliest days”.

So how about the problem of transverse waves needing a solid Ether? Well, fast forward to 1999, Evanston, Illinois: “Northwestern University physicists have for the first time shown that superfluid helium-3... a liquid that has lost all internal friction, allowing it to flow without resistance and ooze through

tiny spaces that normal liquids cannot penetrate – actually behaves like a solid in its ability to conduct sound waves. The acoustic effect provides conclusive proof of the existence of transverse sound waves – which are characteristic of solids but not of liquids – in superfluid helium-3.” William Halpern, the team lead, saw it as “the first observation of a previously unknown mode of wave propagation in a liquid – one that is of the type you would expect to see in a solid.”

Remember the initial hurdle: “It also seemed to be a necessary consequence of the fact that light is capable of polarization that this medium, the Ether, must be of the nature of a solid body, because transverse waves are not possible in a fluid, but only in a solid.” (Einstein). Well, it seems the impossible is possible. The superfluid imitates the solid, and allows for transverse waves.

With this Ether being a constituent of matter, as well as its background, we get Ilya Prigogine’s “Active Matter”, the infinitely deep matter that justifies the arrow of time in thermodynamics. It is the “warm gas” that Unruh’s accelerating observers feel as they crunch the PL field ahead of them, creating an event horizon of their own.

The idea of a Superfluid Universe brings us back full circle, to the much maligned Ether. But this one is a new Super-Ether, Dynamic, fluid, supporting Special and General Relativity, as well as clarifying much of quantum mechanics uncertainty and probabilities. This fluid is moving with the earth, which is why M&M missed it or misconstrued their results. They were looking for a brick building, and missed the river flowing by.

The PLs are the water molecules of this river. They, and not electrons and quarks, are the “fundamental particles”, the absolute building blocks of existence. They are the space, and the energy, all in one. When you zoom in on the needle-point pointlike particles, you will find they are not as sharp as expected, but hide a complexity underneath.

Vigier (a key contributor to the Bohm- De Broglie approach) writes: “In my opinion the most important development to be expected in the near future concerning the foundations of quantum physics is a revival, in modern covariant form, of the ether concept of the founding fathers of the theory of light . It now appears that the vacuum is a real physical medium which presents some surprising properties.” Vigier and Petroni considered the reintroduction of the ether “might well turn out to be one of Dirac’s main

contributions to the new era opened (in the authors' opinion) by Aspect's confirmation of the real existence of superluminal correlations in the physical world", after Dirac's insistence that Quantum field theory requires it.

Quantum Field theory is premised on the assumption that physical reality is non-substantial, and that fields alone are real, being the real "substance" of the Universe, from which "particles" emanate as interactions. As Einstein demonstrated vividly in 1905, matter is energy, and all interactions are interactions of energy ("Dancing Energy" says Zukav). In 1915, he showed that this energy is also the warp of spacetime. Substitute a few labels, and you have our PL picture, supported by both QM and SR/GR.

Frame Dragging effects are a counter-punch to Michelson & Morley's experiments. In them, light traveling in the direction of rotation **will** move faster than light moving against the rotation. It has a micro-analogue in the hyperfine structure in atomic spectra due to nuclear spin. The frame being dragged is spacetime, the new Ether.

John Bell, in contemplating the EPR experiments and non-locality, and the fact that causal influences do go faster than light, presciently predicted: "it may well be that a relativistic version of the theory, while Lorenz invariant and local at the observational level, may be necessarily non-local and with a preferred frame (or Aether) at the fundamental level. Could we not then just omit this fundamental level and restrict the classical variables to some 'observable' 'macroscopic' level?" He thought "an 'Aether' would be the cheapest solution. But the unobservability of this Aether would be disturbing. So would the impossibility of 'messages' faster than light, which follows from ordinary relativistic quantum mechanics in so far as it is unambiguous and adequate for procedures we can perform. The exact elucidation of concepts like 'message' and 'we', would be a formidable challenge". As we have seen, the unobservability of the Aether has been un-confirmed, its definition re-affirmed (by no less than its supposed 'abolisher' Einstein), and the no signaling theorems proved.

In explaining the 1851 Fizeau interferometry experiment, Lorenz provided a detailed dynamic account, based on his theory of the electron, of the microstructure of the moving transparent medium and its interaction with the light passing through it, while Special Relativity's explanation is achieved "without the necessity of drawing on hypothesis as to the physical nature of the liquid" (Einstein). "Lorenz had achieved something remarkable, and

Einstein knew it. In deriving the drag coefficients from principles contained within his theory of the electron, Lorentz was able to reconcile the null results of the first –order ether wind experiments (all of which incorporated moving transparent media) with the claimed existence of the luminiferous ether itself” (Brown & Pooley).

Einstein had been concerned about the distinction in SR between rods & clocks, and the rest of the universe. “This, in a certain sense, is inconsistent: strictly speaking measuring rods and clocks would have to be represented as solutions of the basic equations (objects consisting of moving atomic configurations) ...”. Lorentz’s subsequent explanation of the dynamic nature of the Lorentz-Fitzgerald contraction did just that, using the ether properties. Hermann Weyl himself had looked at the Michelson-Morley null results as a consequence of the fact that “the interactions of the cohesive forces of matter as well as the transmission of light” are consistent with the requirement of Lorentz invariance, and emphasized the role of the mechanics of rigid bodies in explaining the results of relativistic kinematics.

Dirac answered the question: “Is There an Aether?” in a letter to Nature, insisting that objections to an Aether posed by Relativity were resolved by Quantum Mechanics, indicating that his reformulation of electrodynamics showed the vector potential as a velocity. “We have now the velocity at all points of space-time, playing a fundamental part in electrodynamics. It is natural to regard it as the velocity of some real physical thing. Thus with the new theory of electrodynamics we are forced to have an Aether”.

Robert Laughlin says “it is ironic that Einstein’s most creative work, the general theory of relativity, should boil down to conceptualizing space as a medium when his original premise [in special relativity] was that no such medium existed... The word ‘ether’ has extremely negative connotations in theoretical physics because of its past association with opposition to relativity. This is unfortunate because, stripped of these connotations, it rather nicely captures the way most physicists actually think about the vacuum...”. “The modern concept of the vacuum of space, confirmed every day by experiment, is a relativistic ether. But we do not call it this because it is taboo”.

Lorentz, in summarizing his approach to relativity versus Einstein and Minkowski’s, suggested that “one comes to the same results, as if one (following Einstein and Minkowski) deny the existence of the Aether and of true time, and to see all reference systems as equally valid. Which of these two

ways of thinking one is following, can surely be left to the individual". "The chief difference being that Einstein simply postulates what we have deduced, with some difficulty and not altogether satisfactorily, from the fundamental equations of the electromagnetic field. By doing so, he may certainly take credit for making us see in the negative results of experiments like those of Michelson ... not a fortuitous compensation of opposing effects, but the manifestation of a general and fundamental principle".

Many an ether has since been proposed – Wilczek's Grid, John Bell's fermion density field, Anderson's musings about a vacuum emulating plasmas and superconductivity, etc.. "We could have others instead, or in addition. For example the Higgs fields of contemporary gauge theories could serve very well to define 'the position of things'" (Bell). Starkman, Zlosnik & Ferreira propose the ether as a field pervading space-time, which they use to explain dark matter and dark energy

Einstein compared Lorentz's Ether with the "gravitational ether" of General Relativity. "The ether of the general theory of relativity is a medium which is itself devoid of all mechanical and kinematic qualities, but helps to determine mechanical (and electromagnetic) events. What is fundamentally new in the ether of the general theory of relativity as opposed to the ether of Lorentz consists in this, that the state of the former is at every place determined by connections with matter and the state of the ether in neighboring places, which are amenable to law in the form of differential equations; whereas the state of the Lorentzian ether in the absence of electromagnetic fields is conditioned by nothing outside itself, and is everywhere the same. The ether of the general theory of relativity is transmuted conceptually into the ether of Lorentz if we substitute constants for the functions of space which describe the former, disregarding the causes which condition its state. Thus we may also say, I think, that the ether of the general theory of relativity is the outcome of the Lorentzian ether, through relativization". The ubiquity of the EM field, and the Bohm-Aharonov effect, make this a distinction without a difference.

The PL Cosmic Ocean may be a part of the answer. Tesla's intuition of a gas-like Ether may be vindicated still.

"Any particle, even isolated, has to be imagined as in continuous "energetic contact" with a hidden medium". – Louis de Broglie

"When one knows that the Great Void is full of ch'I, one realizes that there is no such thing as nothingness". – Chang Tsai, Chinese sage

“... it would be a great advance if we could succeed in comprehending the gravitational field and the electromagnetic field together as one unified conformation. Then for the first time the epoch of theoretical physics founded by Faraday and Maxwell would reach a satisfactory conclusion. The contrast between ether and matter would fade away, and, through the general theory of relativity, the whole of physics would become a complete system of thought, like geometry, kinematics, and the theory of gravitation”. - Einstein

“The wave, by conventional definition, is a distortion of space; if there is no space, there is nothing to distort. According to Einstein, gravitation is a geometrical bending of space-time, and we accept it. But if space is absolute emptiness, it is impossible to bend it. This is pure logic. But if we refer to the handbook for physics, we will find that an empty vacuum has more than 10 different characteristics, including a dielectric constant, modulus of elasticity, magnetic permeability coefficient, magnetic susceptibility, modulus of conductance, a characteristic electromagnetic wave impedance of 277 Ohms, and other values. Isn't that much for an absolutely empty space?” ☺ - Evgeny Podkletnov

“Newton might no less well have called his absolute space “Ether”; what is essential is merely that besides observable objects, another thing, which is not perceptible, must be looked upon as real, to enable acceleration or rotation to be looked upon as something real”. - Einstein

“The next sign of a breakdown of the quantum theory would be the discovery of some yet smaller dimension whose role might be analogous to the dimensions of an atom in the atomic explanation of continuous matter. We do not as yet know what this dimension is, but it seems reasonable to propose that it could be of the order of the Planck length, where, in any case, we can expect that our current ideas of space-time and quantum theory might well break down”. - Hiley & Bohm

“Physical space and the ether are only different terms for the same thing; fields are physical states of space. If no particular state of motion can be ascribed to the ether, there does not seem to be any ground for introducing it as an entity of a special sort alongside space.” - Einstein

<p>Takeaway: The Ether is there. It is our PL Vacuum. It does not contradict Special or General Relativity.</p>

3.8 - 3-D MAP

“Deeper questions do not arise. Are electromagnetism and particle fields a manifestation of pure geometry? Or is geometry a mere bookkeeping for relations between particles? Or are particles and geometry both primordial? Or have they both derived from something more primordial than either, call it pregeometry or call it what one will?” – John Wheeler

Do we live IN a 3-D world?

Or do we live ON a 3-D map?

Our PL picture says: we are creatures in extra dimensions, “walking” ON a 3-D map.

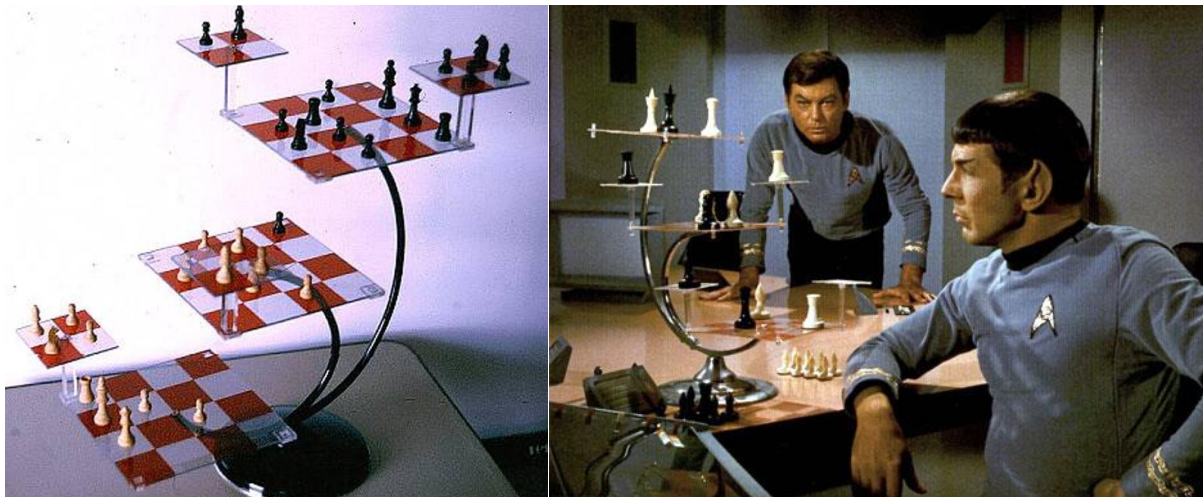
The energy/Mass we are made of, which is a combination of EM energy, Color energy (quarks, etc), is all in the extra dimensions of EM and color.

The 3-D world we conjure up is the Map on which those extra dimensions slide. It is built up by the guide waves and space-time metric, which tell those extra-dimensional clusters where to go.



Think of our 3D world as a chessboard (as Arab philosophers thought of space), on which “particles” and photons move, with the rules provided by the guide waves inscribed on the chessboard itself. To specify an event, you would indicate the starting position in 3-coordinates, the ending location in 3-coordinates, and the “piece” that you moved. Think of the particles as those “extra-dimensional pieces” with different “colors” or EM charges.

Visualizing an extra dimension then is not so hard. A different color piece would represent a different dimension, since the color is another degree of freedom. The colors are naturally “orthogonal” since red does not map into blue or into green. You can think of the number of colored pieces on a square (ok, not chess anymore ☺) as the “amplitude” (or size) of the color in that dimension. In a Hilbert space, those dimensions are infinite, and Nature can select her options.



The rules of the game are provided by the Guide waves of Bohm-de Broglie, with the gravitational component also provided by the metric field, all of which appear as “distortions” in the (somewhat patchy) 3-D map, those distortions (warps) being caused by the effect of the extra-dimensional objects’ presence. “... the wave function, Ψ , describes a qualitatively new kind of quantum field which determines the guidance conditions and the quantum potential acting on the particle. ... it contains active information that ‘guides’ the particle in its self-movement under its own energy. ... the information in the wave function is likewise contained at a more subtle level of negligible energy in a way that has not shown yet and that we have not thus far been able to study.” (Hiley, Bohm).

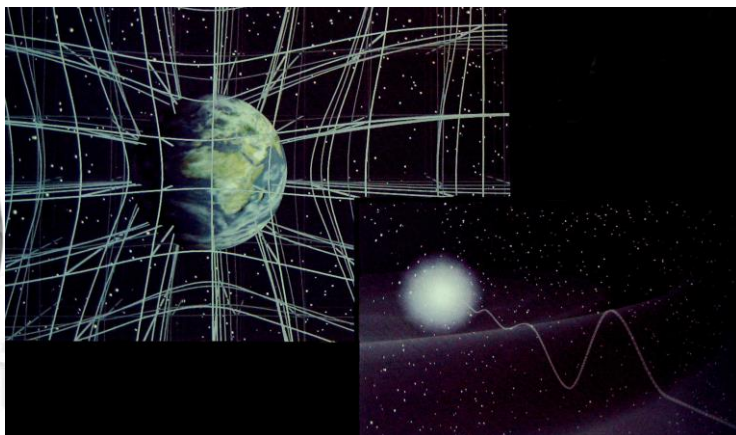
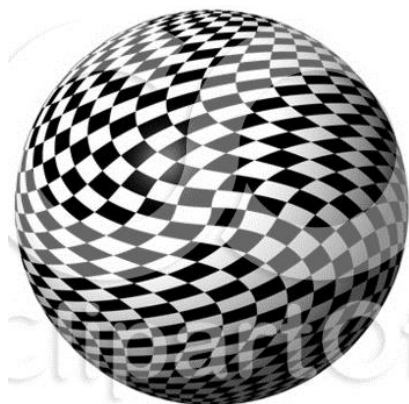
If Quantum Mechanics is about information, and Space-Time about events, then SpaceTime is the roadmap for the movement of this information, and QM provides the directions.

With this picture in mind, we can see how much of the mystery disappears. General relativity, in all its complications, is essentially a result of our insistence to see the world with a set of Euclidean eyes and a Euclidean mind,

whereas the chessboard/map itself is a bit twisted and warped. Non-locality becomes easier to understand when we know the Light speed limit is the limit on the motion of the chess pieces in the extra dimensions (PLCs, photons), but that the chessboard itself can rearrange much faster (PL Mesh motion of the guide waves at near-instantaneous speeds). If we think of the Universe as a tapestry of fuzzy quantum patches of spacetime, continually relating to each other in a hyper-network, then perhaps we could see past this quantum foam to the vacuum sea beyond. You could even see Feynman's "multiple histories" as the particle's menu of potential patches of space to traverse, eventually choosing the "least action path", Max Planck's favorite rule ("occupies the highest position among physical laws"), particles being lazy like the rest of us.

The twisted map/chessboard creates a 3-dimensional Manifold that is intrinsically curved. An observer moving around this manifold will see these chessboard positions sewn together in convoluted ways. While trying to follow a straight line, she may end up having to go around, or look like she is to an outside observer. At the same time, the light or media that convey information about the space also have to travel convoluted paths.

It is as if we are forced to constantly live with fun-house Mirrors all around us. Trying to see a 4-dimensional spacetime in a 3D perspective, like watching the moving shadows of 3 dimensional objects on a 2D surface. In Indian Mythology, "Maya is the illusion of taking these concepts for reality, of confusing the map with the territory", for "all forms are relative, fluid, ever-changing maya, conjured up by the great magician of the divine play" (Capra). But our Minds evolved differently, insisting on constantly "straightening out the mess" but re-aligning it in a Euclidean Framework. We should recognize that our view is our mental construct of the world. And hence the other mysteries appear.





If we add to this the fact that the chessboard is somewhat “loosely arranged”, with the individual places on the board (our PL nodes) loosely aligned, we can see where Quantum Foam comes from at small scale. We can also see how some pieces of the board get aligned firmly (entangled) into a single section, and when we measure (align) one side of that section, we line up the entire section, including any pieces that were on it, a-la-EPR. “Each particle’s spin is probably created *de novo* at the instant of measurement, thereby forcing the opposite direction on the other particle” (Elitzur & Dolev). “A measurement of spin made on one particle instantly resolves (creates?) the plane of spin of the other one” (Philip Clayton). “Thus far, space has generally been considered as a continuum that can be covered by a complex (which is evidently a form of explicate ordering of the space). Such a complex can be discussed in terms of coordinate systems. Thus each simplex can be described with the aid of a locally Euclidean frame, and the whole space can then be treated through the use of a very large number of overlapping coordinate ‘Patches’” (Bohm).

“Geometry ‘is not crazy enough’ to describe all of physics. ... There must be an entity (‘pregeometry’) more primordial than either geometry or particles on the foundation of which both are built”. – John Archibald Wheeler

“Asking the right question is frequently more than halfway to the solution of the problem”. - Heisenberg

One used to believe, and often still finds it useful to postulate, that the source comes first in the science of things, and the field second. However, one sees that today the

possibility is open to think of the field as coming first. On this view the conservation of the source, and therefore in some sense even the existence of the source, is a consequence from and mere aspect of the existence of the field.” – John Wheeler



“..if we think further about our analogy to the behavior of human beings we may note, for example, that in the statistical behavior of moving on roads with signs to inform them, their behavior could in certain cases be calculated from the information implied by the signs without the need for a detailed description of the movement and activity of the human being as a whole, e.g. including his muscles, his senses, his brain and nervous system etc. Similarly, it need not be surprising to discover that the statistical behavior of the particles of physics can be calculated from the information in the wave function without knowledge of the detailed constitution of the particles themselves.”

– Hiley & Bohm



Takeaway: A pregeometry of patchy space rises through its connectivity to generate Geometry and the laws of Physics.

Hermann Minkowski

3.8.1 - BUCKETS OF DUST

Wheeler's idea of a pre-geometry is a brilliant conduit that has encouraged many to investigate such primordial structures that lead to ex-nihilo generation of spacetime. Wheeler thought of the objects in his pre-geometry as logical, not physical objects, with space & time being conceptions of man, and not real physical entities- Its from Bits. Ponzano and Regge expounded this scheme, using Penrose's spin-networks, and their ideas now underlie many Loop Quantum Gravity proposals. Wheeler's dictum of "Law without Law" sees the laws of nature as a statistical consequence of the random behavior of an enormous number of entities working independently in the substrate.

His "Bucket of Dust" idea recalls our PL sea, and Nagel had demonstrated that such a "Borel" set of randomly related points results in a "most likely" 3-dimensional space structure, with only the requirement of "a uniform probability of adjacency between two arbitrarily chosen points". Nagel went on: "Without a background geometry, the simplest way to introduce distance is to specify whether or not two given points are "adjacent". ... We may then say that two "adjacent" points are a distance of 1 unit of length apart." Stuckey and Silberstein used this notion of distance for pregeometry to create pregeometric metrics from which the Lorentzian space-time metrics are derived.

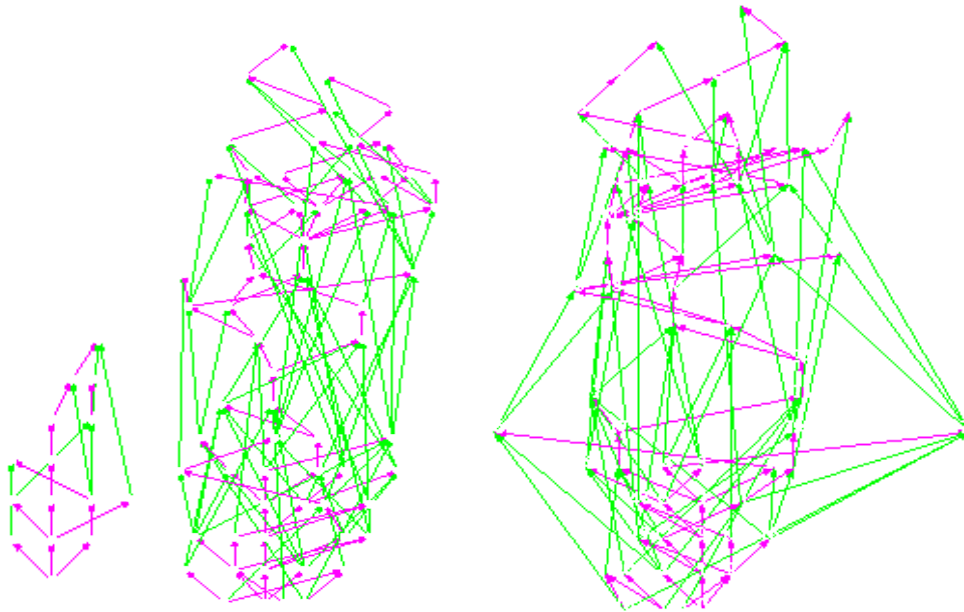
- Proposals such as Hill's discrete spacetime (whose structure is governed by allowed symmetry transformations), and Dadik & Pisk's Discrete-space structure, as well as Wilson's pregeometric graphs, all emphasise the discrete nature of space, and its emergent, relational aspects, using graph networks and introducing creation and annihilation operators for the links in the graph. M. Garcia Sucre proposed a set-theoretical model in which pre-particles (think PLs) are the basic components, with elementary particles as subsets of the power set of preparticles (think PLCs), with the interactions among the pre-particles giving rise to spacetime structures. Bunge starts with elementary particles, forming fields and objects, in a relational configuration from which space is derived, with interactions causing events, Space being merely the collection of these particles and their relations. M. Friedman proposed a similar idea, with the 3+1 continuum

constructed out of the set of related events. Antonsen also devised a graph-theoretical approach, using “random graphs” that are statistical in nature, with time provided by parametrization of these graphs in a meta-space. Lehta proposed a similar approach based on a “abstract simplicial complex” (ASC). The axiomatic pre-geometry of Bergliaffa, Romero & Vucetich presents a similar relational approach. Girelli, Liberati and Sindoni derived a Lorenzian signature and a dynamical space-time emergent from a non-dynamical Euclidean space.

- Volovich’s number-theory pregeometry provides an approach of geometry over a field of rational numbers creating a Galois field where rational numbers themselves undergo quantum fluctuations – somewhat akin to our digital PLs. Horzela, Kapuscik, Kempczynski & Uzes’s Rational Number Spacetime advocates a similar view, where events are mapped with rational number coordinates. Cahill and Klinger’s Bootstrap Universe builds an iterative map composed of Monads, whose relations result in a tree-graph of nodes and links, emerging as distances and as 3-D space.
- Jaroskiewicz and Eakins’ Quantum Automaton Universe closely parallels our proposal, where event states (elementary or entangled) [our PLs] have topological relationships (via operators) that lead to evolution and irreversible accumulation of information, as well as a quantum arrow of time. The proposal incorporates causal set theory and leads to a spacetime consistent with quantum mechanics.
- Kaplunovsky and Weinstein took the notion of the spacetime continuum as an illusion of low energy dynamics, noting that QM is defined without this notion, and quantum degrees of freedom replace the concept of site variables. Boson and Fermion fields are labeled by integer indices, which connect via 1-simplex structures which interact to form N-simplices and SLAC lattices, which then underlie the continuum space-time structure.
- Heller, Sasin and associates used Alain Connes’ non-commutative geometry to build a fundamentally non-local pre-geometry, where even the concept of a point and neighbourhood are not well defined, but where spacetime and QM are emergent at low energy regimes, and the pervasive non-locality at the planck scale carrying over to the EPR entanglement at the emergent scale. They look to unify GR and QM by generalizing the standard space-time geometry to create additional

“degrees of freedom”, with groupoids the basis of their non-commutative approach.

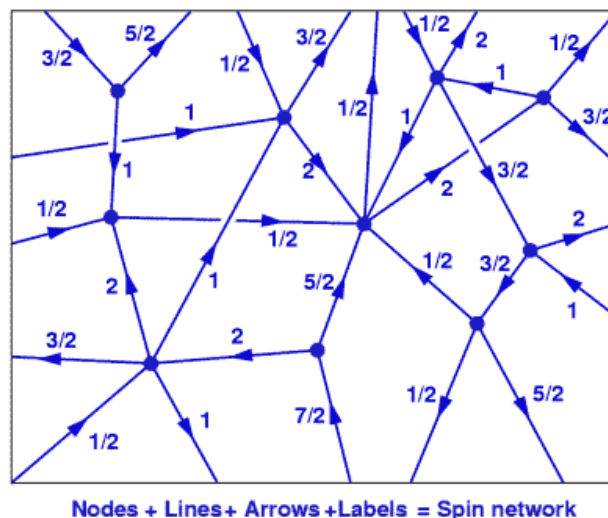
- Other ideas could include causal sets (Bombelli, Lee, Meyer, Sorkin), where locally finite sets of elements with a partial order are linked to the notion of past and future in macroscopic spacetime and causality between point-events. The result is a non-continuous spacetime of finite, ordered elements, with the transition to classical space a result of embedding those sets in the manifold, a coarse grained approach. “The Manifold (M,g) “emerges from” the causal set C iff C “could have come from sprinkling points into M at unit density, and endowing the sprinkled points with the order they inherit from the light-cone structure of g .” (Sorkin). Imagine PLs appearing from the void, and lined up by the travel of Light.
- Alternatively, Requardt’s cellular networks can be used, which describe densely entangled sub-clusters of nodes (characterized by their “charge”) and bonds, that evolve and reconnect (starting from a chaotic pre-Big Bang condition to a more stable present spacetime), with time emerging from an external clock-time, and graphs providing the metric structure of those “cliques” (“maximal complete subgraphs or maximal subsimplices of a given graph” – our PL patches), via a sequential growth process.



- Penrose’s Spin-Networks idea is a leader in proposing pre-geometrical approaches, and is reused in many forms by others, especially in Loop

Quantum Gravity (LQG) approaches. His model deals with objects and their inter-relationships, those objects are “located” directionally or positionally by their relations, so “one does not really need a space to begin with. The notion of space comes out as a convenience at the end.”

- LQG, in its background independent approach, builds spacetime out of its spin-networks. Based on ideas of Abhay Ashtekar, Ted Jacobson and Lee Smolin found solutions to the Wheeler-DeWitt quantum gravity equation using loops, and Rovelli and Smolin developed the idea into a non-perturbative background independent theory of gravity, where geometry is quantized. Thiemann (author with Giesel of the Algebraic Quantum Gravity (AQG) approach, where separable Hilbert spaces are maintained by coherent states, using Algebraic graphs) expanded these ideas with a canonical version of the dynamics. It is the most promising approach to quantum gravity, given String Theory’s inconclusiveness. It has the added virtue of being parsimonious, only needing our perceived 3+1 Dimensional spacetime. Rovelli recently declared: “We have calculated Newton’s law starting from a world with no space and no time”. Time, of course, will tell.



- Chew expresses his view of his & Stapp’s vision of an Event Based Quantum Theory (EQT): “... from the point of view of a quantum starting point, everything is discrete in the beginning, there is no continuum, and the discreteness is represented by the vertices of graphs. The graphs have no metric associated with them, there is no meaning to the distances between two vertices. These vertices I would call the “hard” vertices, and they are interspersed with all the “gentle” or “soft” photon

vertices. There will be an infinite number of superpositions of these gentle vertices, whereas the hard vertices will remain finite and discrete. What Stapp showed ... is that you are led to certain particular superpositions which, in effect, approximately localize the hard vertices. So after you have added this infinite coherent superpositions of soft photons, a hard vertex, which to begin with had no sense of space-time localization, acquires an approximate localization". This way, "you can derive the uncertainty principle and you can derive space-time". If you read soft-photon as our PL, and the "hard vertices" as our PLCs, you have a good match of ideas.

The dimensionality of space-time also comes out naturally from the topology – "The fact that momentum has four components is associated with a 2×2 matrix, and we suspect very much that this matrix is related to these pairs of two-valued orientations, that is to the apparent twoness inherent in the nature of elementary particles." A two valued Logical PL provides that link.

Pauli had predicted: "It seems to me that our present methods are not fundamental enough, and there are two possibilities for overcoming the difficulties. The first is to change our concept of space and time in small regions. The second, to change the concept of state for systems with an infinite number of degrees of freedom... I believe that the development of the theory along the correct line will then lead to a numerical value of the fine structure constant $\alpha = ke^2/\hbar c = 1/137$, and to an explanation of the fact that arbitrary high masses do not appear concentrated in any given space region in nature. It seems likely that future theory will be unitary in the sense that the duality of light and matter will disappear. By this I will not claim that we shall necessarily explain one in terms of the other, but perhaps both in terms of some more fundamental concept." Bohm had looked to Pre-space and pre-geometry as part of his "Implicate Order", with the spacetime of the "Explicate Order" abstracted from this deeper pre-space.

By the way, this thinking is common among science enthusiasts, bloggers, and free-thinkers, waiting for the "establishment" to follow. Here is a quote from a blogger: "So Spacetime, which is a Lorenzian Covariant Entity, is not the truly fundamental property of the universe. Our physics is currently not integrating holistically this critical most fundamental property, which is quantum

entanglement, and so we are unable to unite all our forces on the one single “spacetime tabletop”. ... Spacetime (apparently) is what happens to the Universe after “expansion” into space and time. As “Stuff” expanded away from “other stuff” the “wormholes” connecting this “stuff” together remain and are a “conserved property”, a universal web of connectivity joining all the stuff back together through a kind of “protospace” that subsumes our more common spacetime. Quantum Entanglement occurs in a “dimension” beyond/below spacetime. In that “dimension” events that are separated in space and sometimes by vast periods of time are juxtaposed through a connecting wormhole, and the information in these otherwise separated regions can be exchanged.” “... There are no “brave souls” working in Physics willing to stake their reputations on the “big picture””.

“The Key to freeing quantum mechanics from the tyranny of measurement is to note that a measurement consists of the establishment of a particular kind of correlation between two particular kinds of subsystems”.

- Mermin

“Law without Law” - John Wheeler

“(1) Law without Law, with no before before the big bang, and no after after collapse. The Universe and the laws that guide it could not have existed from everlasting to everlasting. Law must have come into being... Moreover, there could have been no message engraved in advance on a tablet of stone to tell them how to come into being. They had to come into being in a higgledy-piggledy way, as the order of the genera and species came into being by the blind accidents of billions upon billions of mutations, and as the second law of thermodynamics with all its dependability and precision comes into being out of the blind accidents of motion of molecules who would have laughed at the second law if they had ever heard of it.

(2) Individual events. Events beyond law. Events so numerous and so uncoordinated that flaunting their freedom from formula, they yet fabricate firm form.

(3) These events, not of some new kind, but the elementary act of question to nature and a probability guided answer given by nature, the familiar everyday elementary quantum act of observer participancy.

(4) Billions upon Billions of such acts giving rise, via an overpowering statistics, to the regularities of physical law and to the appearance of continuous spacetime.”

3.8.2 - PATCHWORK UNIVERSE

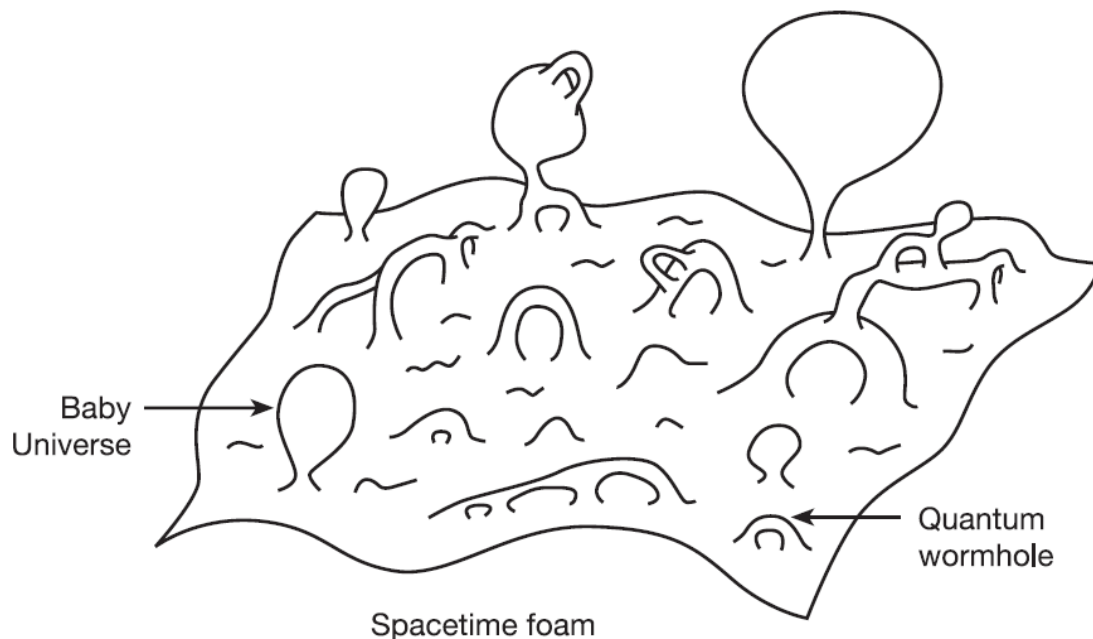
Restating Feynman's basics of Quantum Mechanics (from Peacock):

- Every physical process can be thought of as a transition from a preparation state (call this the *input*) to a number of possible outcome states, or *outputs*. That is, we set up the system in a certain condition, something happens to it, and then we observe what results we got.
- There can be many ways in which a physical system can undergo a transition from its input state to a given possible output state.
- For every possible route the system can take from input to a possible output there is a complex number, called *transition amplitude*, *probability amplitude*, or simply *amplitude*, for that route.
- If there is a way of telling which route the system took to a particular output, then the probability of getting that output is found by taking the amplitude for each possible route, squaring it up to get the modulus (which will be a real number), and then adding the resulting probabilities together.
- If it is impossible to tell which route the system took in order to get to a particular output without disturbing the system in such a way that it changes the possible outputs or their probabilities, then we find the probability of getting a particular output by adding the complex amplitudes together and then taking the modulus to get the probability.

Now think of the Universe as a multiply connected system of "patchworks" of space-time, small islands of the mesh, that are not "aligned" (since there is nothing else to align them until they interact macroscopically). Now think of these islands as the possible routes from input to output that the system can take. With no external interference, the system can travel any one of these patches (Hausdorff Space "neighbourhoods" in a pre-regular space), and arriving at the output. These "Feynman Paths" each has a probability the system will take, creating a possible "History".

This also answers Deutsch's challenge as to where his "Quantum calculations" are taking place. They are taking place in isolated patches of spacetime around the object, not in "parallel Universes" (although in isolation you could think of them as isolated worlds). The Qubit is the various patches assembled. Unlike Deutsch's view, however, the particle is in just one of those patches, and we would not know which until we pin it down- measure it.

The individual 3-D patches can be pictured like two separate spaces interpenetrating each other, easier to visualize in higher dimensions. You can think of the macroworld as a stable, “static” background 3-D space, while the quantum patches are changing leaves floating on that static background and intertwining with it (a kind of extended foam), to be solidly aligned when it actually interacts with the macroworld. Our perception requires a connection between the isolated patch and the whole, and the quantum vagueness comes in the intervening period before that connection is made.

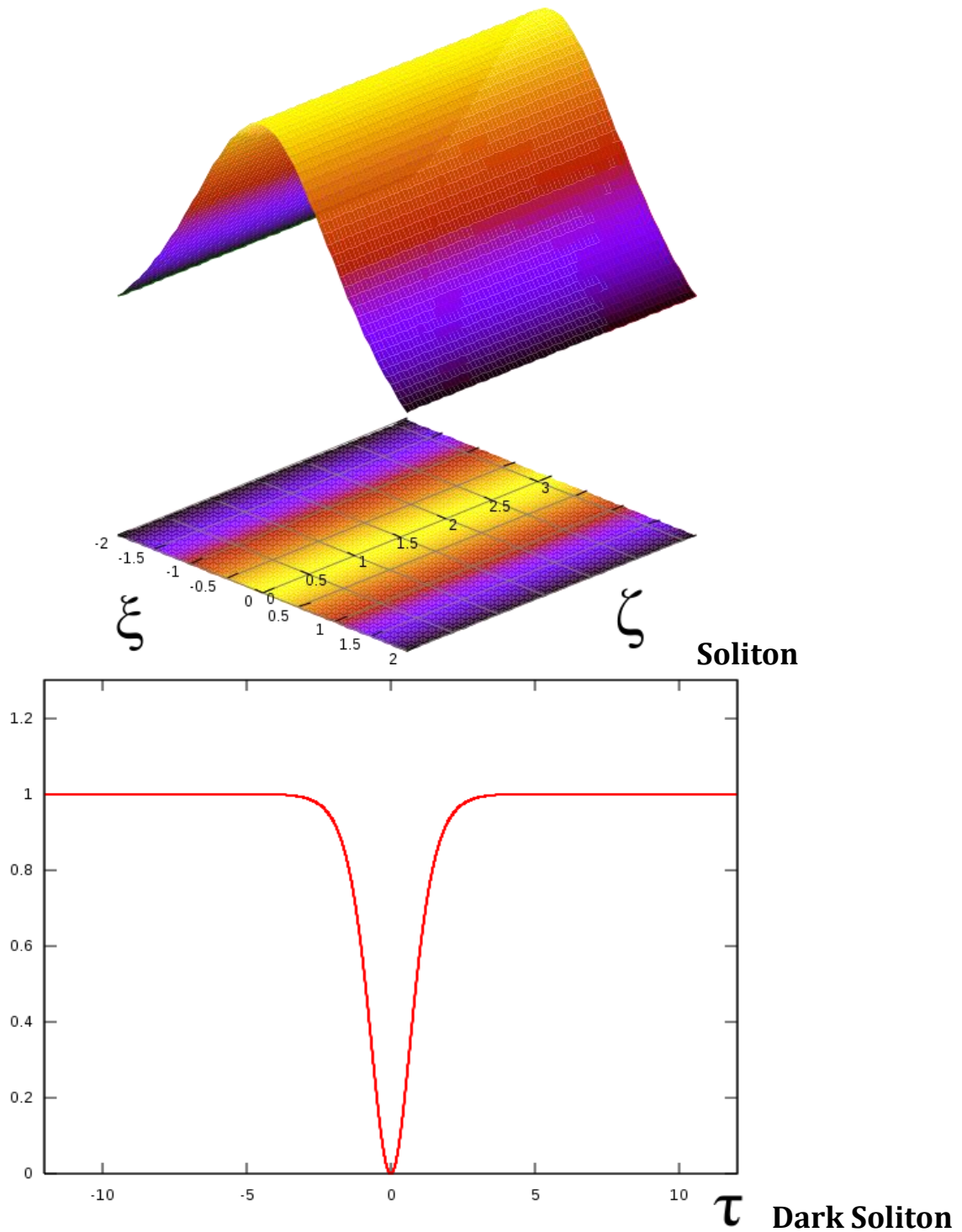


The foamy patches make for a multiply connected space, which one can see as tiny (or not so tiny) wormholes, or bubbles, depending on their shape and how they relate to the “background” space. Their random dance makes non-sense of the common conceptions of space and time.

Could these “separate” 3-D patches and their interactions explain some of the mysteries related to Quasi-Crystals Growth patterns that make sense only in additional dimensions? Illert had indicated the growth of sea-shells seems to require a doubling of 3-D space. Perhaps the interweaving of the foam/patches with the “static” background can provide that loophole for these constructs.

The isolated patches themselves could be “held together” (aligned) by solitons, being waves in the space fabric that move unaltered in shape and speed, going at the quasi-infinite speed of Pls. Multiple mono-dimensional

solitons (the most stable, especially if Dark solitons) could criss-cross the patch, relating its structure and correlating its parts.



The self-phase modulation of the solitons causes self-focusing, and removes any non-linearities in the propagation. It has been shown that many models

have soliton solutions, including the Korteweg- de Vries equation, the non-linear Schroedinger equation, the coupled non-linear Schroedinger equation, and the Sine-Gordon equation. The Schroedinger equations in particular could set the solitons in motion in the isolated patch, creating effectively a topological soliton. A combination of dispersion and non-linear Kerr effect cancel out to allow the solitons to travel without changing shape, except for possible phase shifts. Such solitons are seen in many contexts, such as the Wess-Zumino-Witten model in quantum field theory, cosmic strings, cosmological domain walls, magnetic monopoles, Dirac Strings and other applications.

Solitons, discovered by John Scott Russel in 1834 (his waves of translation), and codified by Korteweg & de Vries in 1895, have been widely used in optics, and are looked at in Neuroscience as possible modes of signaling in neurons. Nature would reuse its tricks at many levels.

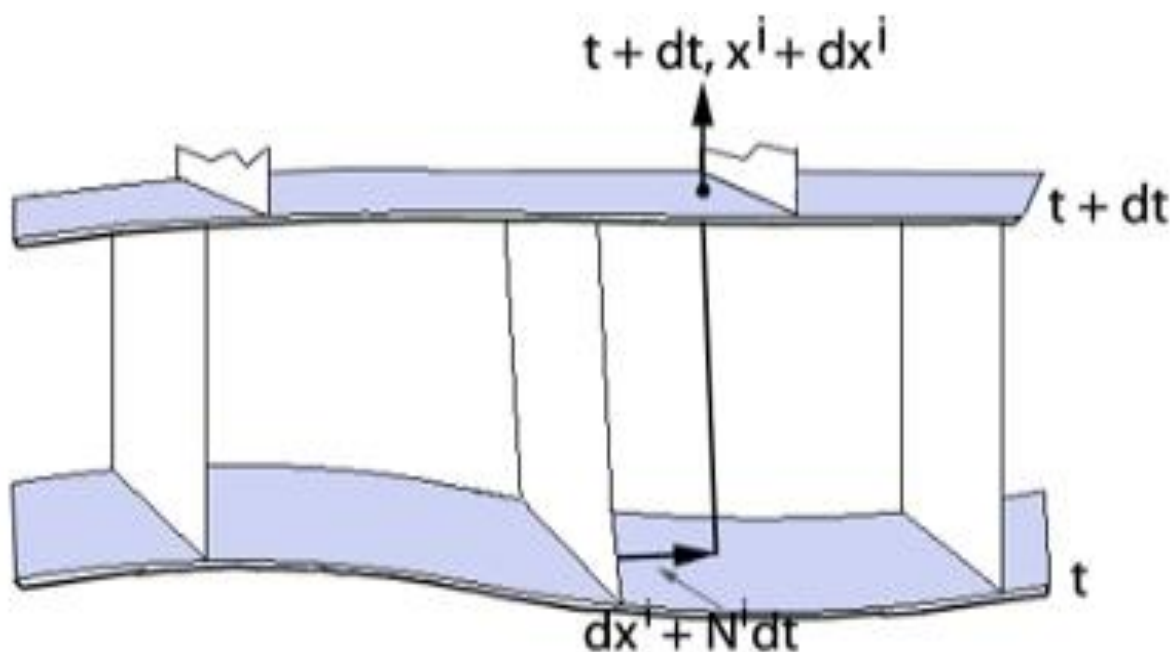
The Soliton waves create a “fiber-like” guiding structure while propagating, and the field will propagate along that guide without changing shape. In optics, these fields can be used as waveguides. In our PL Patch model, those solitons would provide the Schrodinger wave guide, while also keeping the patch coherent and aligned.

Schroedinger himself had spoken of “the *wave mechanical* configuration [as] a *superposition* of many, strictly speaking all, point-mechanical configurations kinematically possible. Thus, each point-mechanical configuration contributes to the true wave mechanical configuration with a certain weight, which is given precisely by $\Psi\Psi$.” One can imagine these “point-mechanical” configurations as the independent patches in the Hilbert Space, and their alignment possibilities as the complete set forming the “wave-mechanical” configuration. The fact that the results of experiments always confirm the conservation of momentum and energy, even while “probabilistic”, implies that we are dealing with a consistent “point-mechanical” configuration (patch) that gets realized (aligned) by the experiment. In an EPR type of entanglement, x_1-x_2 and p_1+p_2 commute, since they relate the two entangled particles with each other, as they are aligned in a single patch.

Dirac had also spoken of the wave function ψ being possibly many wave functions, ψ_n which cannot interfere with each other; the state of the world would be described by these many ψ_n (shades of many-worlds), with nature

choosing whatever ψ_n it pleases. Now think of those ψ_n as the wave function in many potential patch configurations. Dirac then assumed that once nature chooses, it is irrevocable (the phase relations of the wave is destroyed) and affects the state of the future. Change “Nature chooses” to “patch aligns with the macroworld”, and you have our picture. Spin Foam ideas update this concept, where the summation over different sequences of actions of the Hamiltonian can be visualized as a summation over different histories of “interaction vertices” in the “time” evolution sending the initial spin network into the final spin network. With a spin network describing quantum space - aka our “patch”, the sum total of the possible path integrals, or histories, becomes the foamy “quantum space-time”, with only one patch realized in reality.

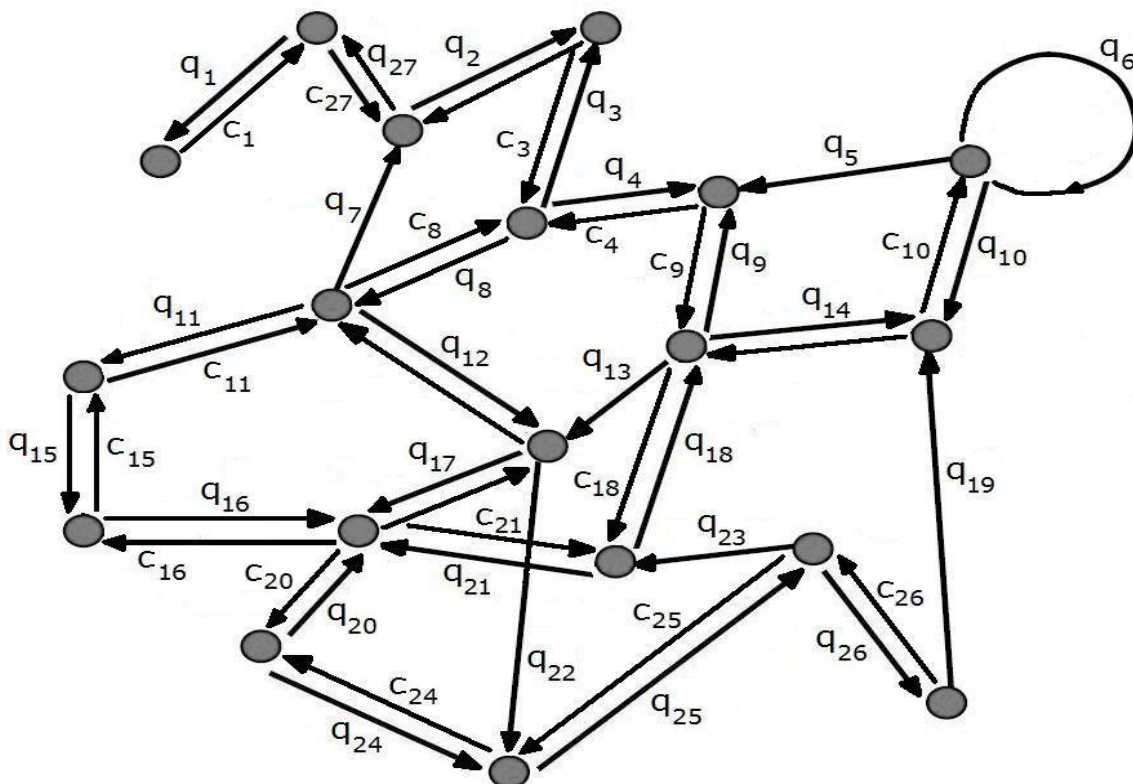
Those patches could also be seen as “sandwiches” of 4-geometry (and local time scale) created by spin networks, as proposed by N. Lafave, leading to Ponzano-Regge spin-networks. Those ideas use Wheeler’s proposal for a “pre-geometry” that creates our spacetime.



Creating a 4-geometry by "sandwiching" two 3-geometries (this is a "sandwich" of infinitesimal thickness): The 4-metric (ie. geometry) of the full 4D spacetime (which is what GR is all about) depends on the lapse and shift of the connectors ("sandwich filling") between the two 3-geometries as well as the 3-metric (the geometry of the "bread"). N is the lapse function (to get the proper time between the upper and lower surfaces you need Ndt) and N^i is the shift function.

3.8.2.1 - UNORDERED UNIVERSE

Marin, Coppola & Colozzo have studied the concept of “non-ordered space-time”, where a set of points in a “Hilbert Space” are connected, with no specific order. They go on to show that this “Chronotope” (Spacetime) arrangement gives rise to gauge fields, and generates a gravitational “force”, which comes out naturally quantized, and easily explains non-locality and quantum entanglement. They see this as an extension of “relativization”, with the “absolute ordering” of spacetime points being an “imposition made by our intellect, rather than a proper quality of Nature”, a “Synthetic proposition” rather than an “Analytic proposition”, following Kant. Their “Arrangement Field Theory” (AFT) creates an “arrangement matrix” M that turns out to act like a field, which also regulates the order of space-time points, and defines derivatives on this non-ordered spacetime. Quantizing M spontaneously quantizes \hbar , its metric. In this scheme, we cannot say “where” a point is, or “when” it is, but just its relationship to “adjacent” points via reciprocal relationships (which could be unequal). Those reciprocal relationships or “contiguities” are not absolute, but “governed by laws of probability like other quantities in QM”. The Universe could be described by this connected network of points and their probability of connection.

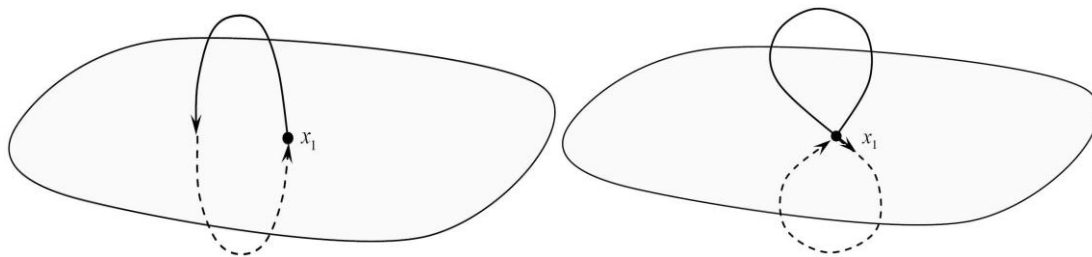


The arrangement Matrix is the ‘machine’ that ‘creates’ joints between the vertices of the ‘space’, with all points connected in a probabilistic manner, with the high probability links being “neighbors”, and loops linking points to themselves (the diagonals of the Matrix). One way links are possible, and lead to non-commutative geometries. The idea is a variation of Penrose’s spin-networks and Wheeler’s spin-foam models, also rampant in Loop Quantum Gravity. “The arrangement matrix regulates the order of vertices in the space-time, determining the topology of space-time itself” (Marin et al.). The probabilities of the links are quaternionic fields, leading to a field metric. “The role of ‘arrangement matrix’ is compared to the role of an external observer”. Second quantization of the arrangement matrix provides creation and annihilation operators for the links. The vertices are the real nodes of space, while the links are the dynamic fields joining them. The nodes themselves do not contain the information about their connectivity, and hence are intrinsically non-ordered. The Links, in their probabilistic dynamics, create the order.

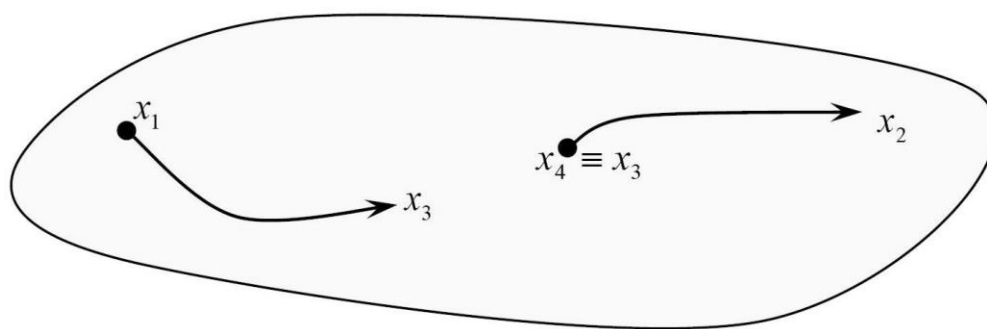
Mapping this to our proposal, one can see the points as our PLs in their motion, following a probabilistic path between nodes. Marin describes this as a variation of Penrose’s spin-networks or spin-foam models. The model does not assume a discrete spacetime, and would also apply to a continuous “Hausdorff” space. Points can be connected “one way” only, leading to a non-commutative geometry. Diagonal elements of the Matrix represent loops, and non-empty elements represent “both a momentum and a probability amplitude for connections between (numerically) consecutive points”. Scalar fields could be added as single-column arrays that multiply the Matrix. The product of the Matrix M and the Scalar field array can be normalized by multiplying with $1/2 \cdot \Delta$, where Δ (length of graph edges) represents a fundamental constant related to the Planck length. The “arrangement coordinate matrix” for the “coordinated field” A turns out to be a gauge field $U(\infty)$. The breaking of the $U(\infty)$ symmetry provides “mass” to the gauge field. This gauge field leads to the standard “action” formula, and the metric h is generated. “We get the “impression” that the metric does not exist “a priori”, but is generated by the matrices D [diagonal]. In other words: **the metric is simply the result of our desire to see an ordered universe at any cost.**” The gravitational field appears as a multiplicative factor when moving from M to its covariant derivative. Again, Mapping to our picture, the Scalar field

would represent the “strength” of the PL field (number of PLs at a point or node).

“Spin” is seen as fictitious rotations in a fictitious tri-dimensional space, a “momentum along those point-wise loops”, resulting from $SU(2)$ residual symmetries from the breaking of $U(\infty)$, and this leads to “an identification between the arrangement field M and the observer that performs the measurement” (in our proposal, alignment of the patch to the macroscopic observer). Fermions represent double loops (two complete rotations, spin $1/2$).

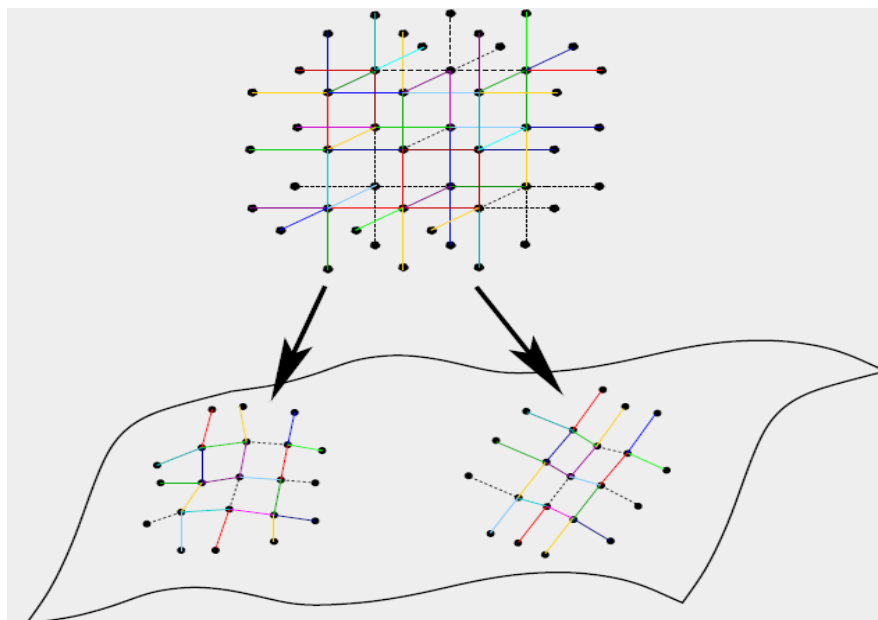


In this non-ordered arrangement, the elements of the matrix M not on or near the diagonal, “describe connections between points that are not necessarily adjacent to each other”. In our PL view, this describes the freedom of the PL to hop past “neighboring nodes”. This leads to effects of “entanglement” and “apparent” superluminal communication, with “apparent” discontinuous paths, and “these discontinuous paths can be considered as continuous paths which cross wormholes”.



Marin extends the analysis to explain how, with the proximity between points being probabilistic, “we have a high probability of receiving two points as “neighbors”, but never a certainty”. Hence in Black Holes certain points could occasionally “distance” themselves from the interior and appear far away, thereby causing Black Hole evaporation. Similarly, the analysis shows the

coupling constant for “gravity” reversing sign at small distances and high energies, explaining inflation and accelerated expansion. The Standard Model and gravity, gauge fields and metrics, and quantization, emerge as a result of our “imposing order over a non-ordered space”.



The AFT and other pre-geometrical proposals bring many useful ideas that could explain the evolution of our PL superfluid, and the inter-relationships of its “points”, leading to the physics of today. They all theorize the emergence of all fields from a single, unique entity. The Hilbert Space of PLs gets ordered by our mind, and space and time emerge, along with the corresponding science. The Neighborhoods of that Hausdorff space would be the patches of space that align, providing the probabilistic aspects of QM, and the entanglement and tunneling phenomena. Interaction between those “patches” (which can be associated with “bodies” or “particles”) “correlates the ‘expectation catalogues’ of data of the individual systems” (Schroedinger), those expectation catalogues represented by the wavefunction.

“The world’s state-vector does not dwell in space and time. Interrogating it leads to phenomena that we call “nonlocal”, which we simply cannot picture in our traditional space-time framework” (Marburger). This is true if we consider space-time our emanent macro space and time – leaving out those “patches” of it outside of “space” and “time”, where the isolated particles, and their wavefunctions, reside.

3.8.2.2 - DEFECTIVE SPACE

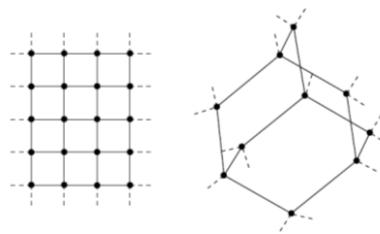
An interesting model that provides a similar framework is Quantum Graphity (Tonopka, Markopoulou & Smolin), a back-ground independent graph based combinatorics and representation approach that differentiates between the states of the Universe in its hot high-energy beginnings and its current low energy state. It sees the initial hot state as a disordered one of high dimensionality, where the graph is fully connected, where permutation symmetries are respected and the average distance between degrees of freedom is small. This is basically a non-local state, where all is connected to all – think of a high PL density where all the nodes are interacting. In this phase, notions of geometry, dimension and topology are vague. The fully interconnected network provides a basis for equilibrium of the Universe at that stage, thereby explaining the Horizon problem, and removing the need for an inflation theory to justify its uniformity.

At the lower energy state, the graphs develop a consistent low-dimensional lattice structure, and the permutation symmetries are “broken” – i.e. restricted to the translation group of that lattice. At this stage, the system becomes “ordered” enough to provide fields in a low-dimensional framework, resulting in spacetime with the usual GR metric. When this transition occurs (Geometrogenesis), Geometry is born. The newly emergent symmetry creates “noiseless” subsystems separated by their environment – particles are born, with their corresponding translational and rotational invariances, and their lattice gauge theory. Those particles (e.g. photons) start a new geometry emerging by their inter-relationships.

An interesting aspect for our purposes here is the possibility that the transition is not complete, leaving many defects and remnants of “disorderliness” in the network, resulting in graphs that only approximately embed in the resulting low dimensional geometries, resulting in defects in “locality”. “The notion of locality encoded in [these] graphs may not completely coincide with the notion of locality given by the emergent metric that describes its course grained properties” (Smolin et al.). I propose that these are our “patches” of the matrix, unaligned, with their disordered locality, that result in the effects of “distant” entanglement of particles embedded in them. I propose this effect is predominant, with locality defined in a macro sense by macro objects and their frequent interactions which align the

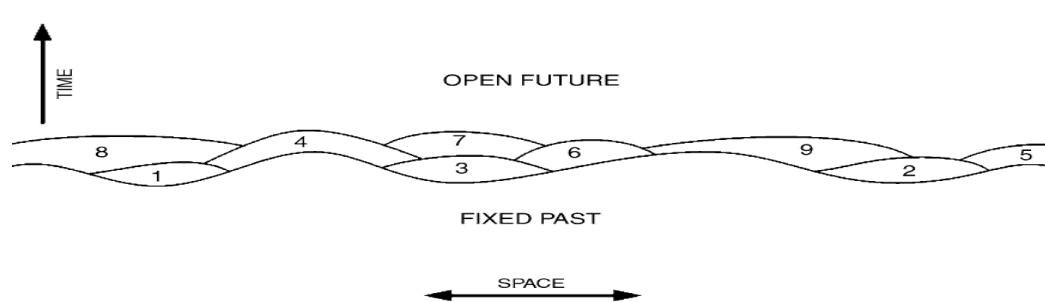
patches continuously, but which loses its effectiveness for micro particles in their isolated patches. The particles travel on the edges of those graphs, and obey the “locality” rules defined by those graphs, until an observation forces them into a different alignment with the coarser grained network. Their random connectivity also allows for faster than light travel across the network. Those “random” graphs outside the mesh are our “patches” of spacetime, the roots of entanglement.

Still, in the low energy regime, the “low valence” of the nodes (more limited connectivity) creates a low-dimensional lattice, the dimensions depending on the preferred configuration. The diamond shape below gives a 3-D world. The regular patterns they present in the form of large, regular lattices can now be considered to be extended space – classical geometry, standard gauge theory and matter fields emerge. The model provides “an example of a broader idea that a distinction between micro-locality (locality between fundamental degrees of freedom) and macro-locality (locality between emergent degrees of freedom) may be important for understanding quantum gravity and the physics of the early universe” (Smolin et al.). The proportion of non-local links left over after the transition dictates many of the mysteries we see in Quantum Mechanics. The “cloud” bell-shapes of QM’s probability functions may reflect that distribution. Smolin sees this “Matrix” of relationships and graphs as the hidden variable sought in non-local hidden variable theories.



Another clue may be in the GRWP (Ghirardi-Rimini-Weber-Pearle) theory (Another favorite of John Bell before his early passing), where decoherence effects are continuously taking place with a timescale of t_0/N , where t_0 is on the order of the age of the universe, and N number of particles in the system – something that can be related effectively to continuous alignments of those patches. Bell highlighted to the GRW team that “the “stuff” is in $3-N$ space – or whatever corresponds in field theory”, to which GRW proposed “the idea that what the theory speaks of, at the appropriate level, is the averaged (on an approximate volume of 10^{-15} cm^3) mass-density distribution of the

whole universe”. Their Continuous Spontaneous Localization (CSL) model was a Bell favorite, but in my view does not supercede the Bohm approach, complementing it instead. The GRW “jumps” in the spontaneous localization serve the purpose of continuously aligning the 3-N dimensional configuration space of the particles with the ordinary 3-dimensional space (and hence Bell’s proposal for those jumps being the “beables” of the theory- while our view is that those jumps enable the realization of other beables). As John had said, “There is nothing in the theory but the wavefunction. It is in the wavefunction that we must find the image of the physical world, and in particular of the arrangement of things in ordinary three-dimensional space”. In our view, all of the dynamical reduction programs (including GRW, Penrose gravitational approach, etc.) boil down to a continuous realignment of the configuration space (the isolated patches) to the “normal” 3-D space (the macro –aligned world). The *trigger mechanisms* of GRW are designed to hit “with a higher probability at those places where, in the standard quantum description, there is a higher probability of finding the particle” (GianCarlo Ghirardi), and “become more and more frequent with an increasing number of particles in the system under consideration”.



Our view of the world of Logical PLs, organized in patches of their own space-time, all correlating to create reality, is a Whiteheadian approach, where the “process” is the essence. Our PLs, or PLCs, are the “actual occasions” or “actual entities” Whitehead projected as the primordial substance, each with its own spacetime region (our patches). Stapp (who is, incidentally, a die hard Copenhagenist, but we’ll use his good ideas anyway ☺) overlapped Whitehead’s approach with Relativistic Quantum Field Theory (RQFT) to see the world as a series of these advancing patches, synchronized together via entanglement, creating the continuous wave-front that is the “Now”, respecting relativity’s ban on superluminal transfer of indormation, while providing superluminal entanglement effects. The numbered patches below result as “Nature’s process assigns a separate spacetime region to each actual

entity” (Stapp). “Every actual entity in the temporal world is to be credited with a spatial volume for its perspective standpoint” and “the actual entities atomize the extensive continuum. This [spacetime] continuum is in itself merely potentiality for division” (Whitehead). *“The wave function evolves beyond the “now”, i.e. outside of spacetime, and its “collapse” due to the interaction with other wave functions creates not only the events, but also the spacetime within which they are located in relation to one another... the wave function, ... is more primitive than spacetime, and the spacetime connecting two events is the product of their interacting wavefunctions”* (Elitzur & Dolev).

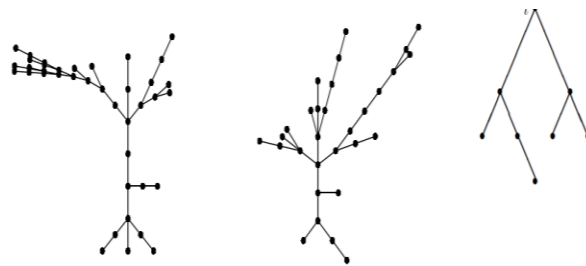
This is an evolving, patch as you go Universe. “...Quantum Mechanics does not describe a world of eternally developing correlation (described by “the wave-function of the universe”), but a phenomenology for investigating what kinds of correlations can coexist with each other, and for updating current correlations and extrapolating them into the future. This phenomenology applies to any system that can be well approximated as completely isolated” (Mermin). Those relations are reflected in QM by the wave function $\psi(A)$, “the projection of the “state” vector $|\psi\rangle$ upon the “detector” vector $|A\rangle$ ” (Marburger). The result of interaction with the Universe, “... depends upon the angle between the two”.

Carlo Rovelli’s relational interpretation of quantum mechanics reflects this approach – “the idea that the theory should be understood as an account of the way distinct physical systems affect each other when they interact – and not the way physical systems ‘are’. ... The physical world must be described as a net of interacting components, where there is no meaning to ‘the state of an isolated system’. The state of a physical system is thenet of the relations it entertains with the surrounding systems. The physical structure of the world is identified as this net of relationships”. “...the values of the variables of a physical system S , namely the q_s , are relational. That is, they do not express a property of the system S alone, but rather refer to the relation between two systems”. “From this perspective, the real events of the world are the ‘realizations’ (the ‘coming to reality’, the ‘actualization’) of the values q_1, q_2, q_3, \dots , in the course of interaction between physical systems”. Rovelli presciently ties this quantum relationism with spacetime relationism, and the definition of contiguity as necessary for interaction in both – a concept he has not developed beyond a simple intuition, which is what our PL patchwork space proposal represents.

3.8.2.3 - A PATCHWORK OF FOAM

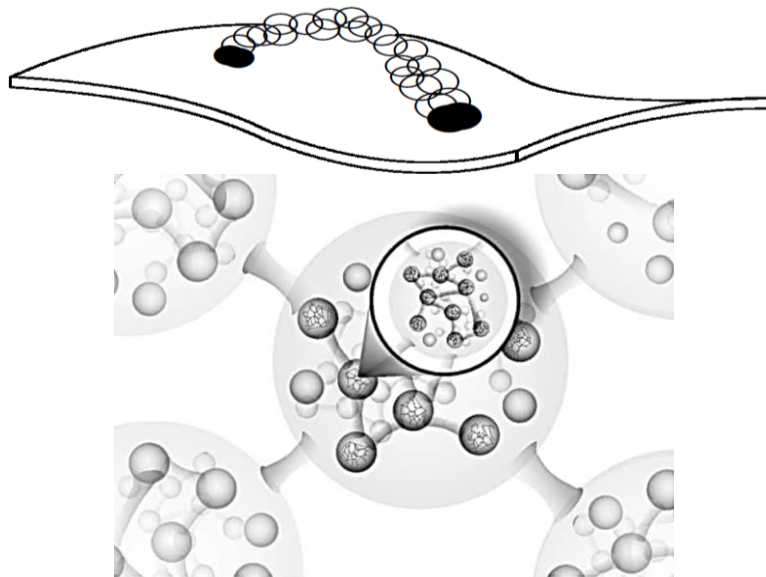
Cahill and Klinger (Flinders University, Adelaide, Australia), in their “Process Physics” model of reality, describe a “Bootstrap” Universe of self-organizing sets of relational information – based on fundamental “Monads” (a-la-Leibnitz). The model is very similar to our PL (our own Monad) proposal, with Space and quantum physics as emergent phenomena. They call it a “Heraclitean Quantum System”, after Heraclitus of Ephesus, the Greek Philosopher who thought that Change is the essence of the world, and that Flux (his Cosmic Fire) explained the essence and continuity of things. His Philosophy of “Becoming” contrasted with Parmenides and Zeno of the Eleatic school, who emphasized “Being”. A non-geometric (pre-geometric) order-disorder model, driven by “self-referential noise”, leads to a 3-dimensional process space, similar to Prigogine’s “dissipative structures”. A Self Organized Criticality leads to a fractal world, with “Information as Physics”, providing a map model of noisy and non-local information systems from which space and time emerge.

The model begins with “Monads” (“pseudo-objects”), very much like our PLs, whose connections are a probabilistic, noisy affair. These are logical entities, with no “substance” behind them, as is necessary for a primordial element-the scaffolding of reality. As these Monads “connect” and relate, they form Trees with multiple connected nodes. The number of nodes between Monads in a tree eventually translate into “distance”, while the clicking between evolutions in the growth and change of the trees grows into “time”.



The trick is that those nodes which are initially (and randomly) strongly connected, eventually collect more nodes, as a noisy process of joining and dissipation occurs, creating what Cahill and Klinger call “Gebits” (Geometrical Bits), essentially “sticky” large, disconnected trees. The process-space self-assembles as Gebits compete for new links and undergo mutation. The resulting patchwork has the interesting property of embedding the tree-

graphs in a 3-dimensional hyperspace. Our 3-D “Space” starts to emerge. The scene is never orderly, with large Gebits “competing and “consuming” noise [transient small trees], in a Darwinian process”, creating a sturdy framework, while smaller noisy structures are also attached and embedded in this “flickering 3-space”. This “Self-referential Noise” (which Cahill relates to Godel’s incompleteness theorem and Chaitin’s information theories) participates in the structuring of the space, creating fractal features, as well as “condensates” of trees. While this Heraclitean Process System is non-quantum, quantum phenomena start to emerge, including non-local aspects through a stochastic hidden-variable like effect, as well as other aspects of emergent complexity. “Process Physics is seen to realize Wheeler’s suggested informational ‘*it from bit*’ program via the sequence ‘*bit -> gebit -> qubit -> it*’”.



The network of self-assembling Gebits forms a 3D fractal process space, as networks of Gebits collect to form larger networks. While the network has non-local connections, it also exhibits a finite speed of propagation of disturbances, “caused by the need for the disturbance to be processed by the formation, interconnection and finally decay of the Gebits”. This process space is filled with self-replicating fractal topological defects, described by a Quantum Homotopic Field Theory (QHFT). Those Topological defects, like knots on a string, survive the ongoing “process of mutation, decay, and regeneration” of the Gebits. Their “winding numbers” translate them into boson and fermion counterparts, with “opposite winding numbers” causing their unraveling, as in matter-anti-matter interactions. The multiple links of a

Gebit afford potential shortcuts or “wormholes” in space that ensure non-locality and entanglement. The Measurement problem of QM is translated to finding the “random contingent truth” (a truth with no explanation, that just *is*) from among the fuzzy set of truths (unprovable, says Godel, in a self referential system) in the Gebit network.

Here we have Wheeler’s space-time “Foam” in action. A fuzzy Homotopy, with one Gebit space linked and embedded into another, simulates that space-time foam. “Space and time and all the objects around us are no more than the froth on a deep sea of randomness” (Chown). It is still a digital, logical foam: “Mathematical Dust” creating matrix-like reality and a Universe. Its time is “process time”, an index to the “coarse-grained ‘history book’” of the evolving Gebit Network. “The ‘beginning’ of a universe is modeled by starting the iterative map with $Bij \sim 0$, representing the absence of order”, and a non-linear, non-local, noisy map leads to the emergence of a dynamical, entirely relational 3-D space, after which the notions of “local” and “position” begin, with small remnants of non-locality supplying the quantum phenomena. At the macro level, the interaction of many sub-quantum systems suppresses this non-locality (i.e., the enforcement of a solid 3-D space), leading to classical behavior (and “measurement”).

Penrose’s view of reduction and decoherence presumes a “superposition of two different geometries is unstable, and decays into one of the two alternatives”. “... Something goes wrong with superpositions of the alternative spacetime geometries that would occur when GR begins to become involved”. “Nature’s criterion for determining when two geometries are significantly different would depend upon the Planck scale, and this fixes the timescale in which the reduction into different alternatives occurs”. He sees the superposed states as independent spacetimes, and tries to make an “*approximate* pointwise identification of their respective space-time coordinates”.

Wheeler, who spawned a lot of this thinking, says “when an orientable 3-geometry is multiply connected, (n handles or ‘wormholes’) superspace has 2^{**n} sheets. Each sheet corresponds to a topologically distinct continuous field of triads that can be laid down on the 3-geometry.” “No dynamics of topological spin and no quantum fluctuations in topology – and therefore, one can believe, no proper treatment of collapse as scattering in superspace –

without change in connectivity; ... The thinning and breaking of a handle makes points that were near suddenly become far. ... Even the concept of dimensionality cannot be applicable at small distances.” Wheeler’s sheets are our patches.

Von Neumann had insisted that “in the measurement we cannot observe the system S by itself, but must rather investigate the system $S+M$, in order to obtain (numerically) its interaction with the measuring apparatus M ”. Our patchwork universe allows us to see this “Shifty Split” (Bell) between the isolated patches of the microworld interacting with the macro world. Rovelli’s relational interpretation says “Quantum mechanics is a theory about the physical description of physical systems relative to other systems, and this is a complete description of the world”. “The unique account of the state of the world of the classical theory is thus fractured into a multiplicity of accounts, one for each possible ‘observing’ physical system”. Neumann’s flexible boundary between measured and measuring system “guarantees the consistency among all the distinct ‘accounts of the world’ given by the different observing systems”. “What appears with respect to [an observer] O as a measurement of the variable q (with a specific outcome), appears with respect to [another observer] O' simply as a dynamical process that establishes a correlation between [the system] S and O ”.

The Belgian school’s “creation-discovery” view of QM says what we call “space” cannot be seen as the “all-embracing theatre of reality, but must be interpreted as a macroscopic structure that has emerged in the same process of emergence of macroscopic physical entities from the microworld. Space is ‘the space’ of the macroscopic physical entities and not of the microscopic quantum entities” (Aerts). “...nonlocality has to be interpreted as nonspatiality. Nonlocal states of a quantum entity are nonspatial states, meaning literally that a quantum entity in such a state is not inside space”. This is our isolated PL Patch. Physical measurements “entail two aspects: (1) the discovery of an already existing reality and (2) a creation of new aspects of reality during the act of measurement”. ‘Happenings’- things already ‘out there’, and the ‘set of happenings’ constitute reality. But happenings are not identical with ‘events’ or points in space-time. They differentiate ‘actions in the world’ from ‘being in the world’. Probability is not intrinsic, and the main difference between classical Kolmogorovian probability and Quantum probability is simply the “nature of the lack of knowledge”.

The “Hidden variables” are in the measurement and the measurement apparatus, not in the entity under study, and as such are highly contextual. The lack of knowledge in this “hidden measurement formalism” is “about the interaction between the measuring apparatus and the physical entity under consideration, hence due to the presence of fluctuations in this interaction” – our PL patch trying to align itself with the apparatus as it comes out of isolation. An experiment provides a ‘real change’ – “the physical act of detection itself ‘creates’ partly the ‘place’ of the quantum entity”. The conflict between QM and GR arises partly from the fact that QM does not operate in the same emanent ‘space’ of GR. The wavefunction describes “a reality that is still not inside space” (Aerts). The position measurement “creates’ the ‘locus’ of the quantum entity, but the entity existed before measurement – QM structure and probability appear as a ‘consequence of considering a piece of the universe, and such a piece that it can only be studied by means of measurements that contain intrinsic fluctuations in the interactions with the piece”. “Classical entities, in this view, are special pieces of the universe, pieces such that there are measurements available that do not have these intrinsic fluctuations” – i.e., they are “aligned” patches.

The paradoxes arise from the way we “penetrate, clothe and decorate reality”, and QM and GR “have great difficulty in recovering and restating carefully what reality is” as a result. “The underlying philosophical idea is that, in the same manner as general relativity has introduced non-Euclidean geometry into the reality of the physical world, quantum mechanics introduces non-boolean logic. The quantum paradoxes would be due to the fact that we reason with Boolean logic about situations with wuquantum entities, while these situations should be reasoned about with non-Boolean logic” (Aerts). Von Neumann’s “lattice structure is indeed to a Boolean algebra what general Riemann geometry is to Euclidean geometry”, due to the fact that “measurements can have an uncontrollable influence on the state of the hysical entity under consideration”. “One must have recourse to a theory that describes reality as a kind of pre-geometry, and where the geometrical structure arises as a consequence of interactions that collapse into the space-time context”. “In its normal state, a quantum entity does not exist in space, it is only by means of a detection experiment that it is, as it were, pulled into space”. “Time-space has come into existence together with the macroscopic entities, and hence it is ‘their’ time and space, but it is not the theatre of the microscopic quantum entities”.

Dirac anticipated our patchwork, seeing the undisturbed systems as independent spaces where classical views held: “Causality will still be assumed to apply to undisturbed systems and the equations which will be set up to describe an undisturbed system will be differential equations expressing a causal connexion between conditions at one time and conditions at a later time”. Per Kragh, “Quantum Physics, he said, consists essentially in relating two sets of numbers: one referring to an isolated system, and the other to the system when perturbed. In order to measure the system, the observer forces it into a certain state by means of a perturbation and, *“It is only the numbers describing these acts of free will which can be taken as initial numbers for a calculation in the quantum theory.* Other numbers describing the initial state of the system are essentially unobservable and are not revealed in the quantum theoretical treatment”. The “theory describes the state of the world at any given moment by a wave function... which normally varies according to a causal law” [our patch], but could split into a series of components [possibilities] “unable to interfere mutually”. “It is nature that chooses” the particular component by the act of measurement. Heisenberg argued that the observer, not nature, chooses, by an act of free will – but that is splitting hairs – the observer being part of nature. In our patchwork picture, “fundamental laws ... control a substratum of which we cannot form a mental picture without introducing irrelevancies”. We speak here of these very relevant “irrelevancies” ☺.

Cahill’s “Process Physics” approach is almost a match of our PL World. A logical world, generated from the emptiness, self-assembled, with our science and reality emergent features. Cahill’s view is interesting: “Special and General Relativity is essentially a model of the potential history of the universe rather than of the universe itself”, where time is not geometry, but a process.

Chaitin, commenting on this and other similar pre-geometric approaches, says: “I’ve seen several physics papers like this that try to get space-time or even the laws of physics to emerge from random structures at a lower level. They’re interesting efforts, and show how deeply ingrained the statistical point of view is in physics, but they are very difficult, path-breaking and highly tentative efforts far removed from the mainstream of contemporary physics”. A good description of the field of pre-geometry, and of this book and our PL World idea as well.

3.8.2.4 - THE VIZIER'S QUILT

This exposition is not meant to be exhaustive or definitive. It points to several and various proposals that make our conception achievable, indicating that a large body of work in pre-geometry has succeeded at explaining how a “bucket of PLs” can produce a 3-D space, metrics, non-local connectivity, and “space patches” that explain the shenanigans of QM as well as the basics of the Standard Model. Which of these Nature chose remains to be verified and tested by its detailed manifestation, but certainly Nature had the tools and means to achieve what we see before us (as if it needed our assent ☺).

Quantum Mechanics had given us the choice between “(1) Phenomena described in terms of space and time with the Uncertainty Principle present or (2) Causal relationships expressed by mathematical laws, but physical description of phenomena in space-time impossible” (Mehra). Like true Trekkies, we refuse to accept this limitation. We choose a picture in space-time, by re-inventing space-time, and explain uncertainty, those “uncontrollable disturbances”. Instead of the world picture being “a photograph which is unsharp or shaken during exposure” or “another of clouds and layers of fog” (Schrodinger), we choose a picture that is focused, but it is a picture of a world that is itself shaken during exposure. We look at a patchwork of isolated particles, whose measurement brings out of isolation, and hence aligns them with the world, bringing the element of “uncontrollable probability”, or entangled ensembles, whose measurement brings them to the world, splitting them into different sub-ensembles (Blokhintsev), and brings out their correlation that existed before the measurement (EPR). In a world “sufficiently complicated, so that it is decomposable into systems and measuring devices” (Mehra), Everett, Wheeler and Graham (EGW) saw the state vector of the isolated system “collapsing” into the “state vector of the whole world” of Daneri et al, that vector being the macro-classical world, and that collapse brings with it the statistical aspect of nature.

Prigorine et al, following ideas from thermodynamics and statistical mechanics, looked at the evolution of systems by splitting them into independent subdynamics, defining time-symmetric sub-spaces of the “superspace”. The superspace is maintained by those correlation processes of the subspaces which have long “duration” and show up macroscopically. Quantum Mechanics is then seen as the “macroscopic” level description of the

variables and interactions of these subspaces. In a similar vein, Ludwig saw the world as the interaction of ensembles, with the quantum systems determining the macroscopic variables through their interactions, resulting in smaller degrees of freedom. Microscopic ensembles “merge” into the macro ensemble which is the smooth function of the macroscopic variables thus engendered, and this merging resulting in the “smearing” effects of QM.

Bohm & Vigier, following an idea of Furth, saw an analogy of the uncertainty principle to Brownian motion. Although Brownian motion seems random and undetermined, it is actually well determined by molecular impacts, as Einstein aptly proved. B&V saw Quantum Mechanics at the level of Brownian motion, whereas an unknown sub-quantum mechanical level corresponds to the molecular motion level, with this sub-QM level containing “hidden” qualities and variables, from which the various constants, including Planck’s constant “h” can be derived. The statistical behavior of this sub-QM level would provide the observed QM results. This sounds very much like our PL proposal, with the PL-world being that sub-QM level, and PLs being the “Prima Materia” B&V saw as composing that level. Carrying the analogy further, Bohm thought the QM level theory would break down at very short distances and times, where the sub-QM level dominates. The wavefunction would then represent the substratum and the statistical conditions in the sub-QM level.

John Bell (in ‘Subject and Object’, “Speakable and Unsayable in Quantum Mechanics”) approaches this idea of a patchy spacetime, by defining “the ‘system’ under study simply as a limited space-time region. This seems a less intrinsically ambiguous and unrealistic way than any other I can think of to separate off a part of the world from the rest”. “In the approach known as the ‘theory of local observables’ a Heisenberg state (pure or mixed) can indeed be attributed to a limited region of space-time. It gives, roughly speaking, the expectation value of all functions of the Heisenberg field operators with space-time arguments in that region. If something like a Lorenz-invariant causal connection between field operators is postulated then the region of relevance of the state vector can be extended by including all points whose forward or backward light cones pass entirely through the original region...”. “It is then the Heisenberg state of the extended region which reduces, whenever a ‘local beable’ in that region is attributed a particular value, to its projection in the subspace with the given eigenvalue. Whatever the particular space-time location of the beable considered, there is no question of any particular space-

time location of the associated state reduction, which is coextensive with the whole history of the system under study.” “...when a particular member state of the incoherent superposition is specified, definite values are specified for all beables. Thus the theory is of deterministic hidden –variable type, with the Heisenberg state playing the role of hidden variable. When this state, which may originally refer only to the limited region in the figure, is specified, all beables in the extended region are determined” (Bell). “space-time, being a property of the detectors, not the underlying stuff, is a macroscopic phenomena” (Marburger).

Looking at the world as a patchwork of mini-spaces, joined in places, disjoint in others, on average presenting a quilt of classical order, allows us to form a picture of how order comes out chaos, and how pre-geometry brings Geometry into being. But like orderly kingdoms, beneath the surface lurks many an independent vagabond, patches of space unlinked to the main quilt. These are the domain of the “isolated” particles, or systems of entangled particles, that live in their own subspace, unseen and unheard, and hence unreal (as QM would have it). They are in their own space and time. When we catch them (read ‘measure them’), we find (1) that we are surprised with what we find (‘uncertainty’ in their position and motion) and (2) we also ‘find’ their entangled partners (‘entangled particles’) in crime, which are obviously correlated with them. Before we ‘find’ (‘measure’) them, they were not there as far as we were concerned – they were ‘potential’ probabilities. Once we find them, they become a part of the system (‘macroworld – classical world’). The statistical aspect of their alignment could very well be the “hidden variable” in Bohm’s mechanics.

“Einstein had no difficulty accepting that affairs in different places could be correlated. What he could not accept was that an intervention at one place could *influence*, immediately, affairs at the other” (Bell). Our Patchworld picture provides the compromise needed: While the transport of energy/particles/signals still obeys SR rules, the “patch alignment” provides for the immediate correlation. A world in which each particle is not just located at a space point, but carries with it also its own patch of space, which together sews the entire fabric of spacetime, can resolve the apparent paradox. It preserves ‘local causality’, and ‘no action at a distance’, Einstein’s sacred cows, while allowing ‘correlation at a distance’, QM’s indisputable fact.

Bell had come close to enunciating this concept, while describing his own unique view of Everett's Many-Worlds concept. He thought that "Indeed it can be maintained that there is no need whatever to link successive configurations of the world into a continuous trajectory. Keeping the instantaneous configurations, but discarding the trajectory, is the essential (in my opinion) of the theory of Everett. ... Thus instantaneous classical configurations x are supposed to exist, and to be distributed in the comparison class of possible world with probability $|\Psi|^2$. But no pairing of configurations at different times, as would be effected by the existence of trajectories, is supposed. And it is pointed out that no such continuity between present and past configurations is required by experience".

Bell asked: "Could it be that the first observation somehow fixes what was unfixed, or makes real what was unreal, not only for the near particle but also for the remote one?" The answer in our picture is yes. The observation makes real what was unreal, folding in the isolated particle: "Esse est Percipi". It fixes the unfixed: an isolated particle in its own patch is nowhere and notime (wandering about the "sum over all possible paths" of Feynman), until synchronised with the macroworld by the observation, and is thus "fixed". And doing so brings in its entangled particle as well, since they share a common patch. The particles did have real properties before the measurement, and were already correlated, but the measurement brought those into the "framework" of the classical macroworld. Clearly QM did not have a way to encapsulate this concept, and hence was incomplete, as the EPR authors thought. What was missing was a conception of a discrete, dividable spacetime, semi-chaotic (foam?), embedded in (and constituting, when averaged out) the classic spacetime we know. The Patches of spacetime were missing.

Looking at the Girard-Rimini-Weber (GRW) proposals, one can start to read their small regular jumps as continuous patch alignments ("a galaxy of such events" (Bell)). Their wavefunction in multi-dimensional phase space is where we must find "an image of the physical world, and in particular of the arrangement of things in ordinary three-dimensional space. It has neither amplitude nor phase nor anything else until a multitude of points in ordinary three-space are specified" (Bell). "Schoedinger's greatest contribution to science was the discovery of quantum phase as a new feature in the underlying geometry of nature ... the geometry of our world, in the vision of

Weyl-Schroedinger ..., is therefore that of a one-dimensional fiber bundle over the four dimensional manifold of space-time" (Marburger). The GRW jumps "are well localized in ordinary space. ... So we can propose these events as the basis of the 'local beables' of the theory" (Bell). Their time constants of $\sim 10^{8}$ yrs and distance of $\sim 10^{-5}$ cms, leading to typical jumps every $\sim 10^{-5}$ seconds are close to what one would expect in a world enmeshed by the ubiquitous CMBR. GRW continuously commits the wavefunction back to reality and alignment. While the GRW proposal assumes these jumps are random and spontaneous, our patchwork world gives them a basis and an ontology.

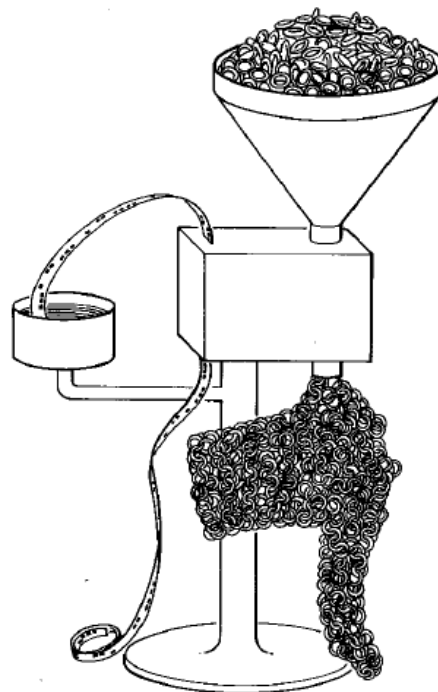
All of a sudden, the language of Quantum Mechanics sounds like the language of Einstein. Instead of the exorbitant "Many Worlds" scenarios, we have the "Many Patches" scenario, its chaos more like what we expect of life. We can re-read *and understand* Jordan: "the electron is forced to a decision. We compel it *to assume a definite position*; previously it was, in general, neither here or there; it had not yet made its decision for a definite position... we ourselves produce the results of measurement". The "floating", isolated patch, simulating "superposition" of the "wavefunction" possibilities in its unattached state, "entangled" in its unity, is "reduced" when it touches something (is "measured"), and it "collapses" into a distinct alignment with the macroscopic world it just bumped into – it is "realized". Before that, it is just a "consistent history", a possibility out of many in a family of "consistent histories", a "branch" if you will of many-worlds. All the terminologies start to converge.

The laws of Quantum Mechanics are valid in the very special circumstances when a particle is effectively decoupled from the rest of the universe. "A pure quantum process occurs only in a parameter, or set of parameters, that are detached from the rest of the universe and leave no trace of their behavior until a measurement interaction takes place. We should perhaps be more surprised by the fact that quantum theory allows us to say anything at all about the behavior of a quantum system between measurements than by our inability to make a precise description in this realm" (Rae). If we take Alain Aspect's "Naïve View of an Experimentalist", and look at EPR measurements as a two step process, the first measurement defines the polarization of the first particle, and instantaneously projects the second particle into a polarization parallel to the results of the first measurement. Since the

quantum mechanical prediction is a function only of the relative angle between the two measurements, a “super-luminal” alignment of the subspace will guarantee agreement with those predictions. It is a classical physics explanation with a twist, the twist being the fragmented spacetime.

Think of separate floating patches as “wormholes” in space, tying the component particles. A Measurement cuts the wormhole, and ties the particle to its macro environment.

The Mysterious becomes ‘Anschauliche’. EPR’s entangled photons (that “onslaught that came down upon us like a bolt from the blue” (Rosenfeld)) are one system, as Bohr thought, joined by their common patch of space and superluminal wavefunction, and remain so until a “measurement” aligns their patch and “separates” them. We do not need to bring in observers, consciousness or Mind (sorry Stapp), those being self-organized complexities generated by the emergent world, software on our brain’s hardware, but not necessary for its realization. Uncertainty & probability remain, caused by discreteness, waves, and the isolated patchiness. Entanglement is simple space-time patch alignment, and no longer so spooky.



Wheeler’s Vizier’s “Machine of Ten Thousand Rings”, how the Universe is knitted together. From a bucket of Borelian Dust, through a Logical proposition Machine & Quantum probabilities, comes pregeometry, Pregeometry creates Geometry. Geometry creates Physics, Physical laws and Matter.

3.8.2.5 – MAKING WAVES

So if the world is an emergent structure of a patchwork of logical assemblies, then how do we explain the “solid” Universe we see around us?

Clearly the emergent structure is sturdy and resilient. The time evolution of the links and relationships should enforce the stronger links (as in Gebits), and create a stable background in which evolution and physics can take place. The various ideas suggested for this network of nodes all converge on such solutions (Graphity, AFT, etc.).

But all proposals still foresee transient patches, “noise” and “fluff” in the network, as the dynamic space mesh evolves and interacts. While a “rigid” framework sustains the solid illusion, it is rife with renegade subspaces that continually connect and reconnect, as we’ve seen in their entanglement effects and non-locality, and continuing alignment on measurement.

Besides this noise, the space mesh will also experience many macro effects as it is continuously buffeted by large “bodies of matter”, creating waves in the fabric. Some of these take the form of Gravitational waves that carry “energy”, but most will be ongoing undulations and space-time waves as the mesh structure accommodates to the “motion” and disturbances of large bodies, as well as ongoing transients from the first creation. Such structural changes in the spacetime mesh will then affect the flotsam (matter, and us) drifting on it, as it affects the basic parameters of our existence: space and time.

Enter the Schnoll effect.

Dr Simon Schnoll, a Russian Biochemist, noticed that many of his detailed measurements and histograms exhibited sharp peaks and variations, inconsistent with the expected stochastic distribution of the experiments. It seemed like he got different behavior depending on the location and time the experiments were run – so much for the homogeneity and isotropy of space and time! Ignoring his teacher’s advice (“Don’t do so many repetitions and this effect will disappear”), he continued testing, and branched out into many other fields, including radioactive decay – with the same pattern of results. 50 years of measurements convinced him that “this is not an experimental error but [a] manifestation of fluctuations caused by cosmophysical factors”. “The phenomenon can be the result of fluctuations of four-dimensional space-time, related to non-uniformity (heterogeneity) of [the] gravitational structure of

the world. ... The histogram patterns are like interferencial (sic) pictures and may be the result of interference of coherent cosmogonic waves” (Schnoll). “In gravitation theory it is assumed that at [the] planck scale spacetime acquires a foamlike structure as a result of quantum fluctuations. If we believe in the fact that our Universe had a quantum period of evolution in the past, then we should expect the existence of traces (relics) of such fluctuations at macroscopic or even cosmological scales. ... a nontrivial quantum structure of our space at macroscopic scales ... gives rise to a new fundamental phenomenon: spontaneous origin of an interference picture in every physical processes ... which can possibly serve as a test of the real structure of space” (Kirillov).

The patterns displayed the effects of heterogeneity in different places, impacted by earth’s rotation, sidereal and solar daily periods, disposition of nearby celestial bodies, yearly periods, latitude, directionality (using narrow beam collimators), and lunar and solar eclipses. All pointed to space-time changes “emerging from the rotation of the earth around its axis and the movement of the planet along its circum-solar orbit”. “The evidence points unambiguously to the existence of a *previously unknown relationship* between fluctuations in the rates of radioactive and other processes in the laboratory, and major *astronomical cycles*” (Tennenbaum). “Schnoll’s work shows that time is heterogeneous. It is not a Newtonian time. Each moment in time is different from another, and this can be seen in any physical process that you study” (Voeikov). This “suggests as a possibility the notion of a global “change of space-time structure”” (Schnoll). As a side note, D. S. Chernavskii comments: “the postulate of measurement in quantum mechanics is at least not complete”.

The directional effects clearly show that the underlying space has structure, and one that is heterogeneous and anisotropic on many scales, reflecting both the current celestial structure as well as accidents of its birth. The Spacetime formalism encodes the dynamical effects of this structure, and therefore varies with it.

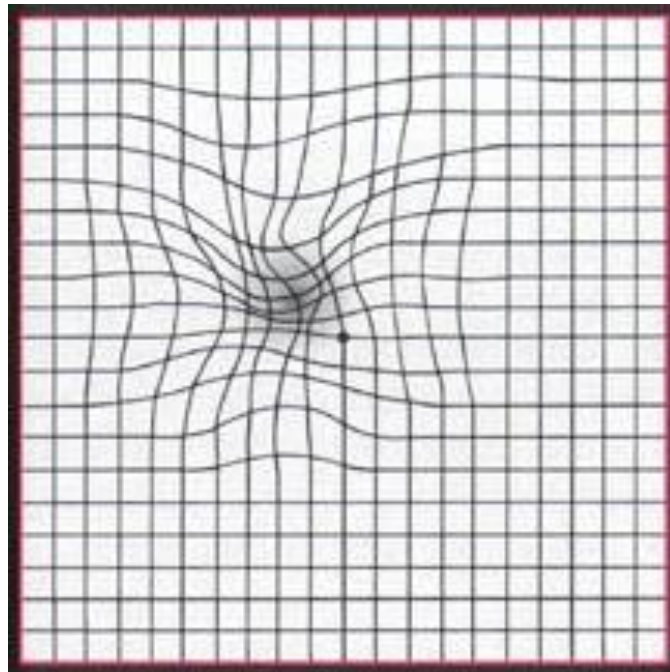
The ubiquity of the patterns, from biochemical reactions to noise in gravitational antennas to alpha-decay, and their wide scale range (40 orders of magnitude), discounted an energetic source, and implied something “noncasual” (Schnoll) was changing in the “foundations”. The Chirality of the

histograms hinted at an immanent chirality of space-time itself. While gravitational waves can justify some of these effects, other space-time disturbances must also be at play. By affecting the very structure of space-time, including the fine structure constant, time and distance, it impacts every aspect of the observable world. This provides a new opportunity: by studying specific processes and their variations, we may be able take a peak at the mesh itself, something we have no hope of doing energetically in our accelerators. We can use this noise and fluff as an experimental tool to understand the basic infrastructure of our world.

3.8.3 - A LAYERED WORLD

The picture we end up with describes a multi-layered world, with each level differing in size, role, and complexity.

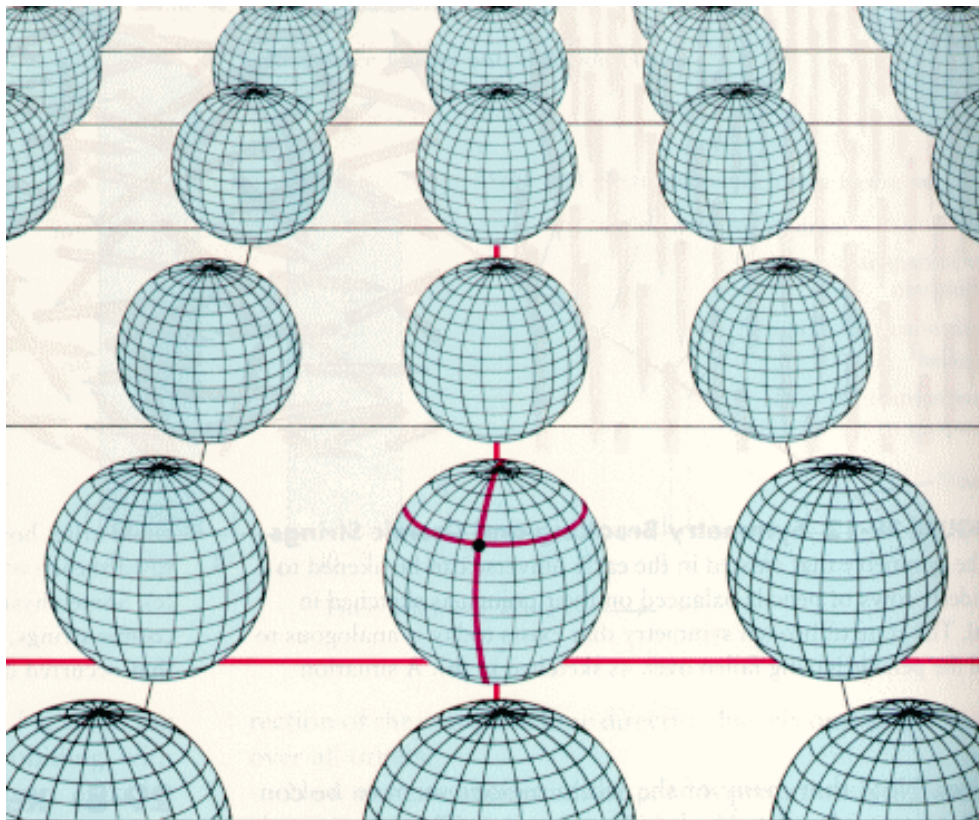
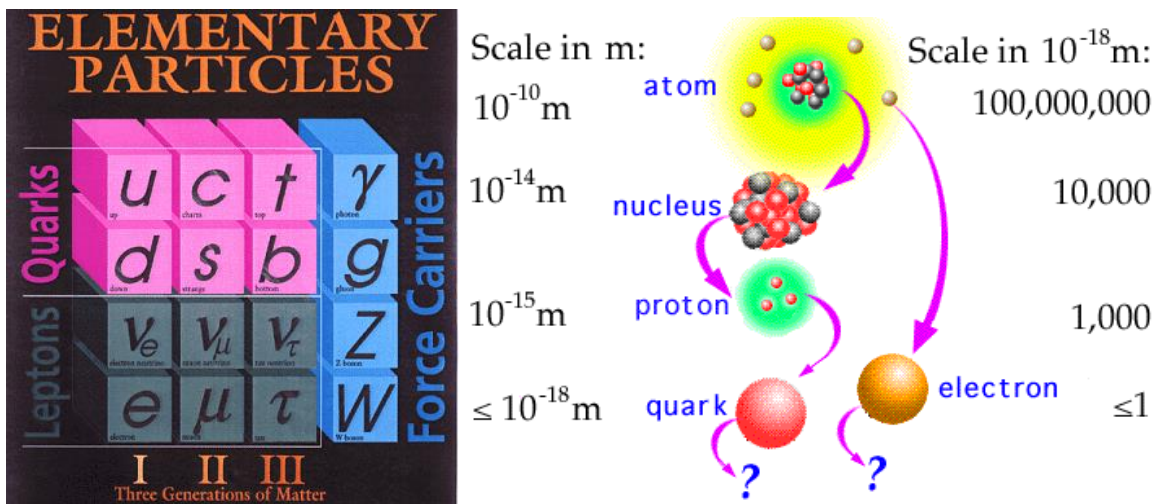
- PL Layer: This is the **planck size** Mesh layer, a 3D construct of PLs, providing the underlying Map of reality. Its contents include individual PLs representing the Nodes of the Mesh (the empty flat space Mesh), as well as PLs representing the Quantum Guide waves and the Gravitational potential, being reflections/ impacts from the second higher layer that “shape” and warp the mesh, at the same time guiding the motions and behavior of elements of the second layer.



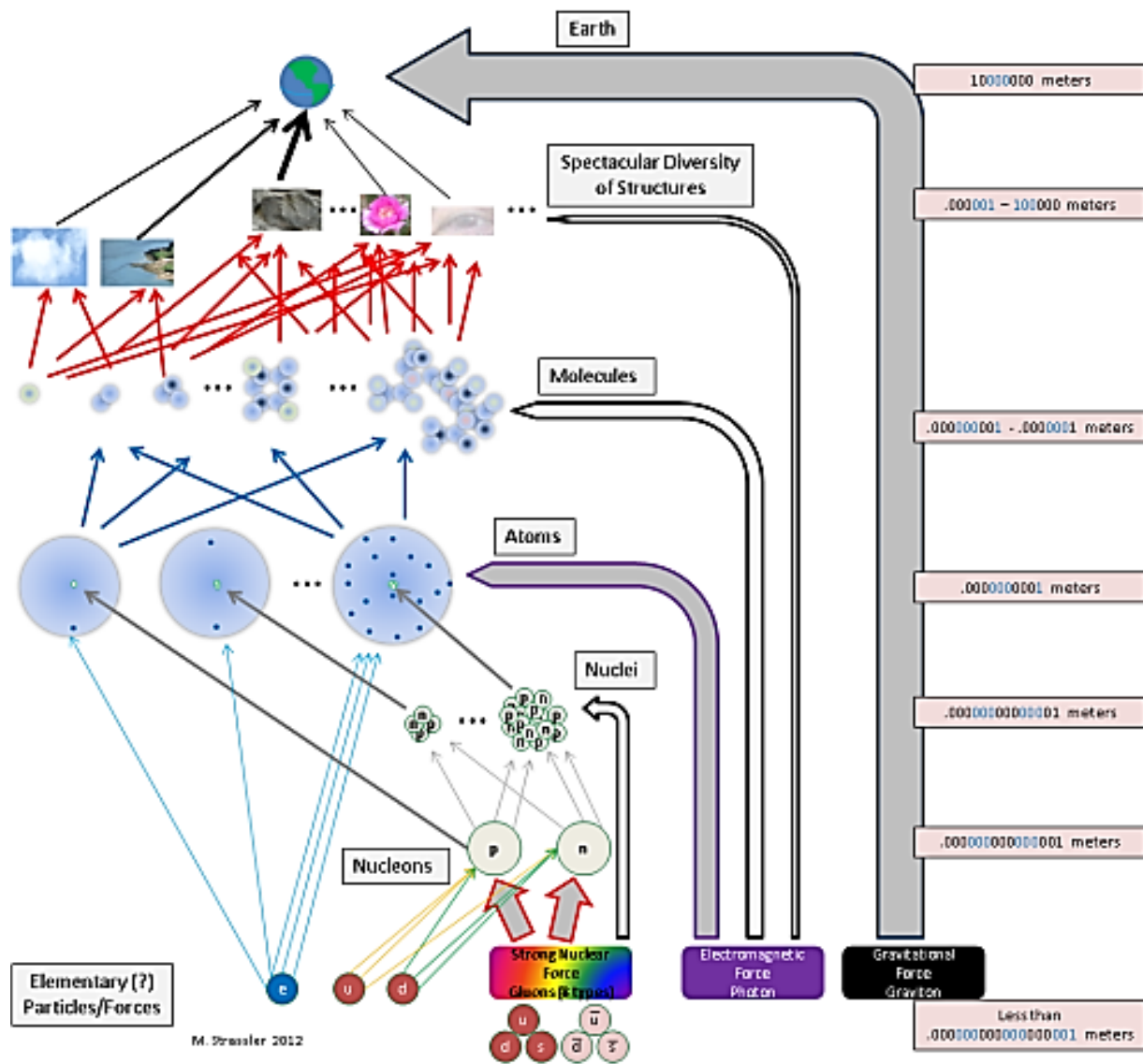
This world has no speed limit, and forms an Ether backdrop to reality. Its energy is thinly distributed, but since it covers all of space, it represents the 70% or so Dark Energy of the Universe. It is continuously generating its mesh, resulting in the expansion of Space (which it represents).

- Microworld Layer: This is the matter/energy particle size layer, made of nuggets of energy (PLCs) in additional dimensions (EM and color dimensions). They are superimposed on the 3-D Map level below them, and are guided by the Guide waves in the PL Layer. This layer contains

the bulk of what we perceive as mass and energy (excluding Dark Energy).



- **Macroworld Layer:** This is the evolved world of reality built up by the interactions of the Microworld inhabitants. The elementary particles of the Microworld join and react to form molecules, cells, stones, trees, humans, planets, solar systems, galaxies, and all that we see.



All three layers are made of one prototypical essence, the PL, a Logical entity. The rest comes out of logic, information, and mathematics, that create geometrical formations, clusters, interactions, concepts (space & time) and ultimately intelligence.

“Through our eyes, the universe is perceiving itself. Through our ears, the universe is listening to its harmonies. We are the witnesses through which the universe becomes conscious of its glory, of its magnificence.”

— Alan Wilson Watts

“universal matter, immesurable time, boundless ether, triple abyss os stars and atoms and generations” - Teilhard

3.9 - PILOT PLS

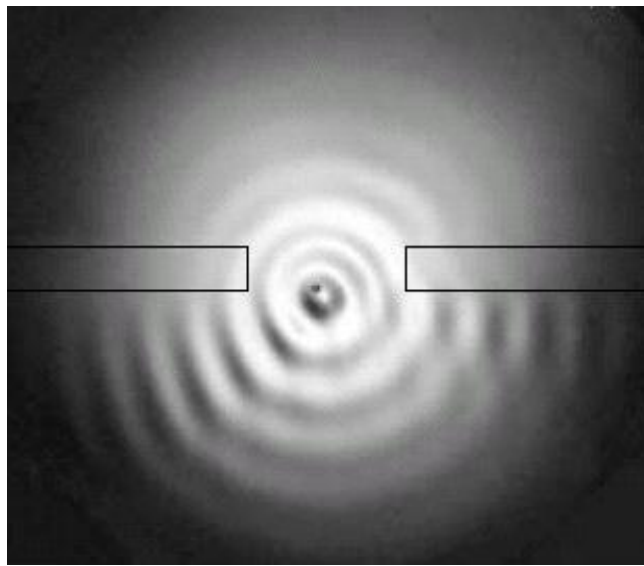
The motion of PLCs is seen as “guided” by their entanglement with “Pilot PLs” straying from the PLC cluster, basically elements of the cluster “drifting” in a wave front in the 3-D mesh from the PLC (in its color dimension). This is the key to the “particle” – “wave” duality. This is Einstein’s Gespensterfeld, the Phantom Field, whose waves guide the particle-like photons on their path. Born’s (and eventually De Broglie’s and Bohm’s) interpretations are generalizations of Einstein’s phantom field to Photons and other particles. The Pilot PLs replicate the wave function of the “particle”, without carrying much of its energy. In case of very massive particle agglomerations (neutron stars, quasars), these Pilot PLs can translate still to energetic gravitational waves. They are Bohm’s Pilot waves, an unfolding of the Space metric impacted by the presence of clusters of PLs (Matter), re-writing the usual rules of what defines a straight line, the highway of the Universe. The Pilot waves are the curvature of 3-D space.

The “Jumps” of Quantum Mechanics correspond to PLCs “moving” suddenly to locations and formations guided by those Pilot PLs. “Moving” here is a mathematical construct, the PLCs in their correlations taking a different configuration in Hilbert Space, corresponding to the changed location or energy, after a “momentary” drive into the “Abyss” Born could not explain. That “Abyss” (Abgrund) is the Nil-source, the Netherworld, where PLs drift in/out of existence, but where their logical correlations are maintained, keeping a semblance of “continuity” (which we see as “reality”). Those jumps are not “sudden”, but short transients, as the Bohmian model suggests.

The correlation with the Pilot waves is the “probability wave” of Heisenberg (his concept of potentiality), a quantitative formulation of the concept of “possibility”, or “potentia” of Aristotle’s philosophy – that “intermediate layer of reality”, halfway between the massive reality of matter and the intellectual reality of the idea or image, “a strange kind of physical reality just in the middle between possibility and reality”. That probability is driven by the action of the Pilot wave, which varies depending on its “hidden variables” (like starting position, etc).

The PL Pilots are the base of the “double-solution” of De Broglie, which saw the photons and quanta as “Singularities” in a field of waves, with these “mobile singularities” being our photons and particles. His view was that

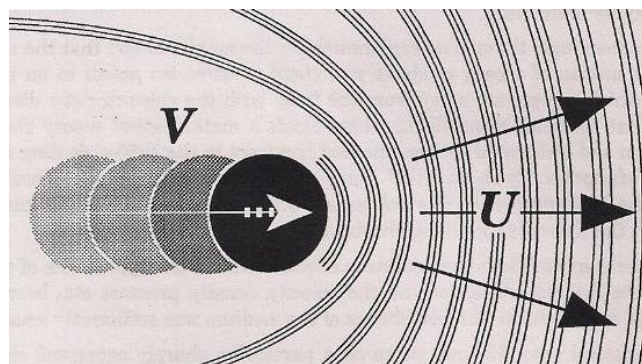
those discrete structures of matter and radiation provide an overall “statistical” information which we interpret as matter and energy, especially in the form of singularities. His wave equation provides two solutions: a continuous statistical aspect, and a singularity solution which constitutes the particles under consideration. The parts of the pilot wave that carry the “particle packet” guide its motion, whereas the rest of the wave, “the empty packets, which also satisfy Schrodinger’s equation, constitute a vast mass of ‘bits of reality’ that are, as it were, ‘floating around’ interpenetrating that part of reality which corresponds to the occupied packets” (Hiley, Bohm). Those “channels not occupied by the particles correspond to inactive information.”



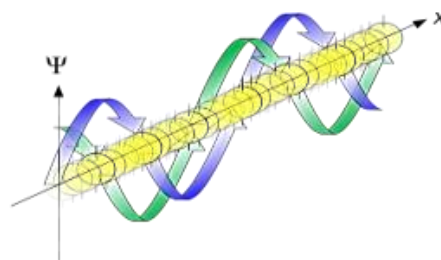
Slater had conjectured that the atom, even before a process of transition between two stationary states takes place, is capable of communication with distant atoms through a virtual radiation field. As Renninger proposed (along with some enlightening thought experiments) that the duality of wave and particle is not a restriction on observation technique as Bohr’s complementarity proposal implied, but is and can be exhibited simultaneously in the same experimental arrangements, concluding that “every quantum is an energy corpuscle which is “carried” or “guided” by an energy-free wave”, our low density PL Pilot wave being essentially that “energy-free” wave. His “thought experiment” suggested a photon is a particle which traverses a continuous trajectory in space and time, but also spreads out like a field or wave. Einstein was excited about this concept, which removed the need for otherwise “telepathic coupling between objects in different regions of space”. Max Born even thought this the way forward, with both “particles and waves

having some sort of reality”, even though “waves are not carriers of energy or momentum”.

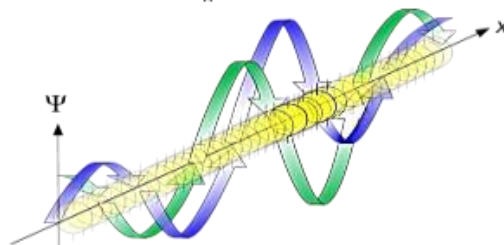
It is the interactions of the Pilot waves, which are ubiquitous and superluminal, that determine the mysteries of interference and entanglement. Wondering about interference fringes that “arise if and only if there is no possibility, even in principle, to determine which path the particle took” (Zeilinger & Brukner), and why “it is not relevant whether or not we care to take note of that information” as long as “the information is present somewhere in the universe”, the answer is: the Pilot wave knows. By its superluminal nature is it everywhere, and encodes the information of the entire setup. It can “see” the setup, “as long as it is there, no matter how well hidden or how dispersed”, and by configuring itself to that setup informs and directs the particles to behave accordingly. Mystery solved.



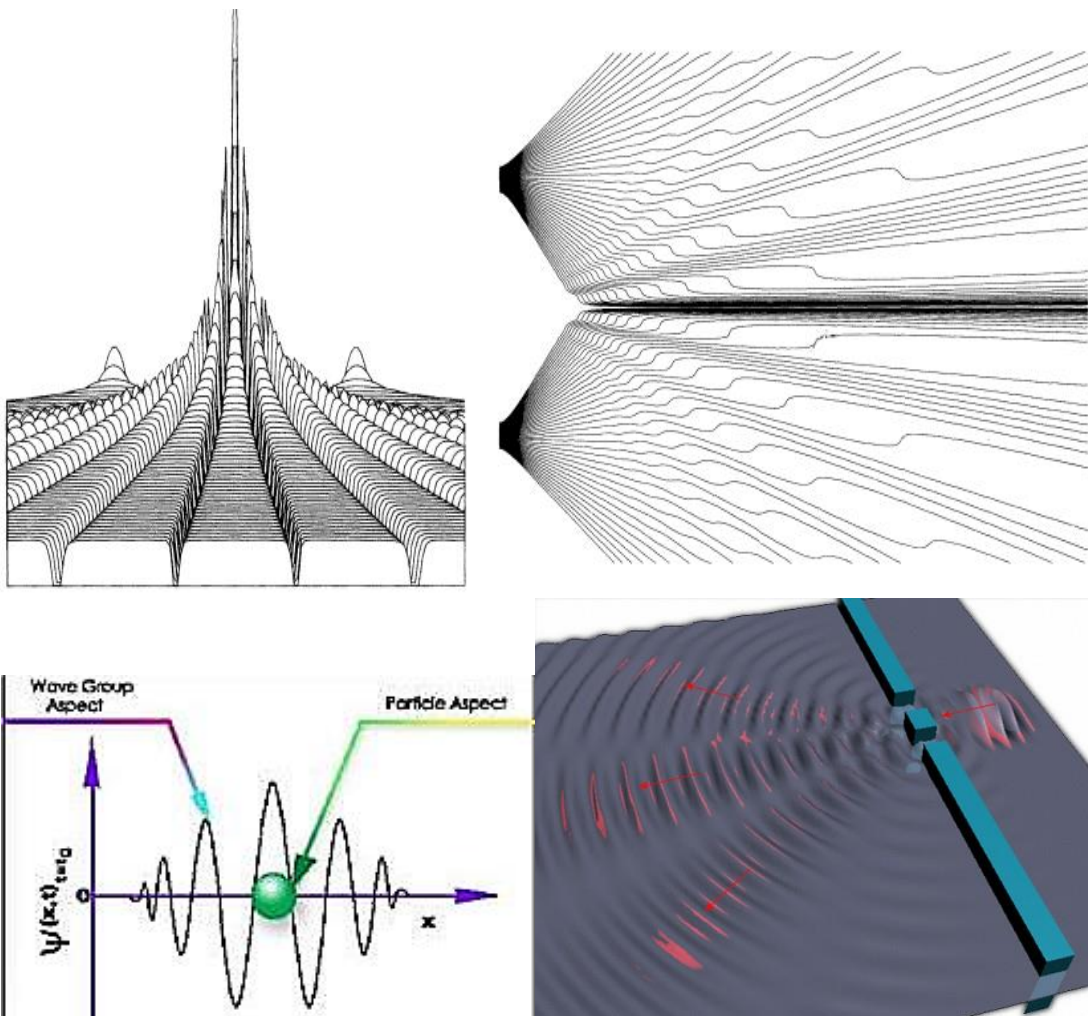
$$\Psi = Ae^{i(px - \omega t)}$$



$$\Psi = \sum_n A_n e^{i(p_n x - \omega_n t)}$$














De Broglie Waves; plane waves & wave packets

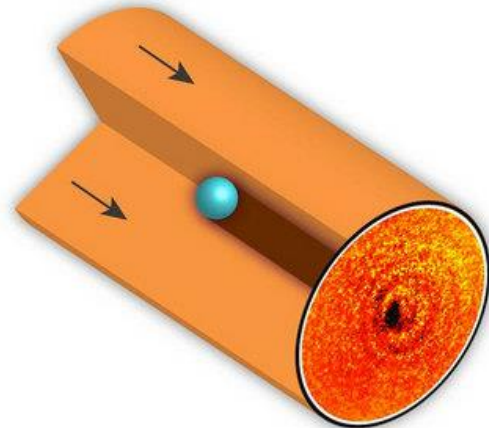
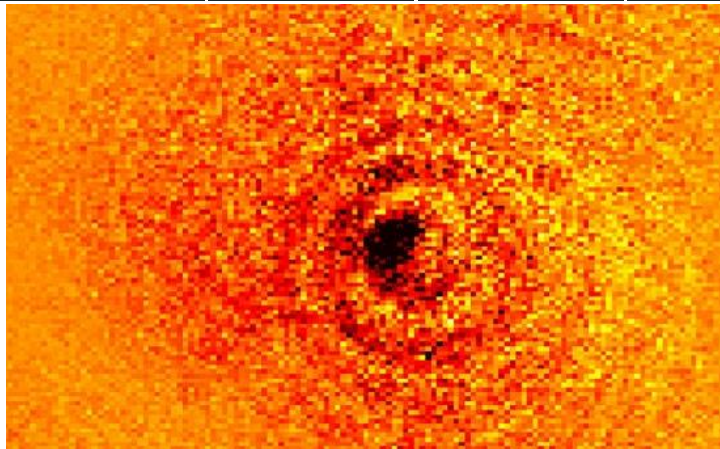


“While the founding fathers agonized over the question ‘particle’ or ‘wave’, de Broglie in 1925 proposed the obvious answer: ‘particle’ and ‘wave’. Is it not clear from the smallness of the scintillation on the screen that we have to do with a particle? And is it not clear, from the diffraction and interference patterns, that the motion of the particle is directed by a wave? De Broglie showed in detail how the motion of a particle, passing through just one of two holes in screen, could be influenced by waves propagating through both holes. And so influenced that the particle does not go where the waves cancel out, but is attracted to where they cooperate. This idea seems to me so natural and simple, to resolve the wave-particle dilemma in such a clear and ordinary way, that it is a great mystery to me that it was so generally ignored.” - John Bell

“One will assume the existence, as distinct realities, of the material point and of the continuous wave represented by the function, and one will take it as a postulate that the motion of the point is determined as a function of the phase of the wave by the equation $v = -1/m_0 \cdot (\hbar \nabla \phi)$. One then conceives the continuous wave as guiding the motion of the particle. It is a pilot wave.”

- De Broglie

					
<u>Max Planck</u> Quantum Physics Discrete Light Quanta	<u>Albert Einstein</u> 'Photon' Quantum Theory Photoelectric Effect	<u>Niels Bohr</u> Quantum Physics Copenhagen Interpretation	<u>Louis de Broglie</u> Physics Matter Waves Particle Wave Duality	<u>Erwin Schrodinger</u> Quantum Physics Wave Equations	<u>Max Born</u> Quantum Physics Probability Waves
					???
<u>Werner Heisenberg</u> Quantum Mechanics Uncertainty Principle	<u>Paul Dirac</u> Quantum Physics Dirac Equation	<u>Richard Feynman</u> Quantum Physics Electrodynamics QED	<u>John Bell's Inequality</u> Quantum Mechanics EPR Paradox	<u>David Bohm</u> Quantum Physics Bohmian Mechanics	



Shallow cast by single atom (Griffith University, Australia)

Takeaway: The massive, energetic radiation or particles, being in an additional dimension, send a reverberation in the 3-D space. This sympathetic wave represents the wavefunction / Pilot wave of the particle in the 3D space, which guides its motion in that space, while forming that space itself.

3.10 - DE-BROGLIE & BOHM'S LEGACY

"To admit things not visible to the gross creatures that we are is, in my opinion, to show a decent humility, and not just a lamentable addiction to metaphysics."

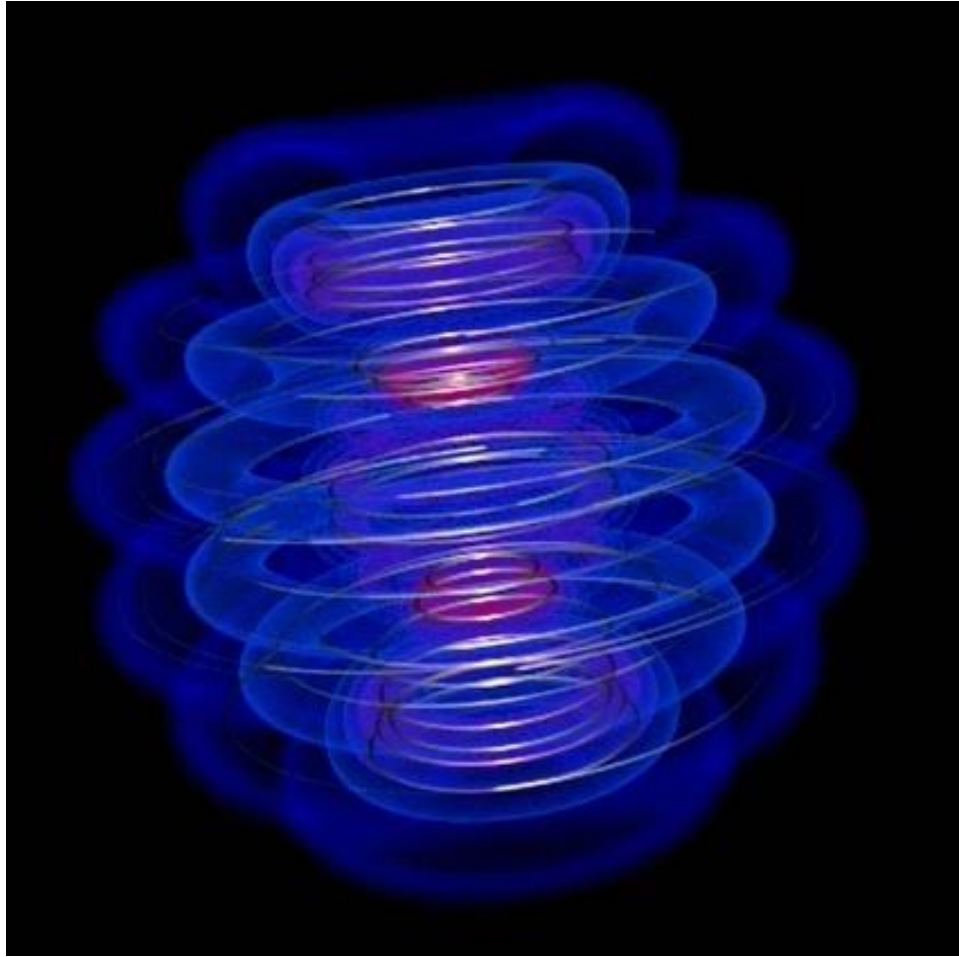
- John Bell

When the philosopher Paul Feyerabend asked Bohr to clarify some questions he had about QM, Bohr, who had just read Bohm's update of De Broglie's Pilot wave theory, exclaimed: "Have you read Bohm!"? "It seemed that, for him, the sky was falling in". Bohr was amazed, as well he should have been.

Bohm did not "Turn" Bohr the way Einstein had turned him in the course of one conversation. But he turned many others, like Hilary Putnam, who came to see the theory as consistent as well as elegant.

What Bohm had done was to extend and generalize De Broglie's original Pilot-Wave idea (which De Broglie dropped in hesitation soon after expounding it, only to return to it repentant in his later years), the idea that originally motivated Schroedinger's equation, with Schroedinger trying to describe De Broglie's waves on his way to eternal fame. Schroedinger's work is based on the model De Broglie built. Bohm also included a measurement theory, something needed to explain decoherence (well before it became the current catchphrase in QM). De Broglie was the "biological" father of Pilot Wave theory, but Bohm is the kind adopted father who nurtured it.

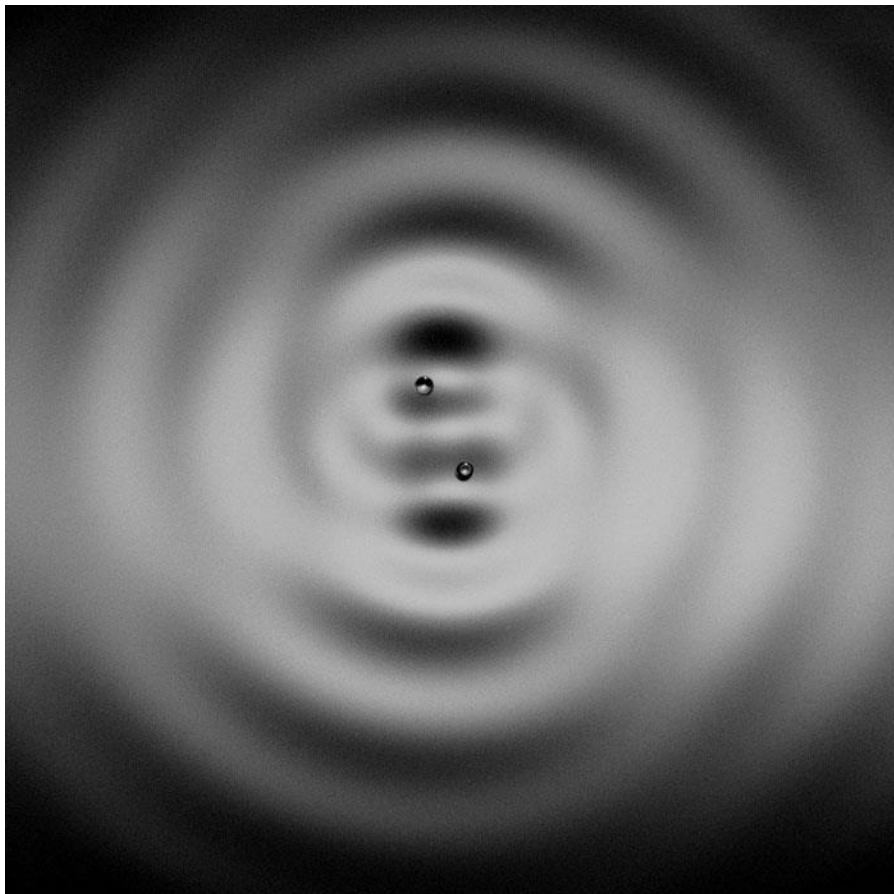
Mike Towler of the Cavendish Laboratory in Cambridge has a beautiful expose about the origins of this theory, and its dramatic and tragic history. Like Mike, and since I am proposing a Pilot Wave approach that posits this theory, I am clearly advocating that approach as "the" solution for a pictorial view of QM. It is a minority view in Physics still, but a growing minority. It certainly is no longer a despised, ignored minority – no one today would call Bohm a "public nuisance", or his work "juvenile deviationism" (except Mermin, who recently called it a "deviant subculture"), as many did, including Oppenheimer (who suggested "if we cannot disprove Bohm, then we must agree to ignore him.") – partly because of his communist tendencies- ironically the same charges were later tossed equally unfairly at Oppenheimer. John Bell, a staunch advocate, thought "it remains, in my opinion, well worth attention as a model of what might be the logical structure of a quantum mechanics which is not intrinsically inexact".



The dominant Copenhagen clique has written the books of history since the start, and influenced the next generation which followed somewhat blindly – the experimental success of QM enough to scare challengers, especially when added to a McCarthyism of sorts in academia against such rebely. So we get Landau and Lifshitz who can say, without blinking, that “In Quantum Mechanics there is no such concept as the path of a particle.” That “Religious” edict, even against the better judgement of early QM giants like Einstein and Schroedinger, became the QM dogma, even when the De Broglie proposal offered a clear alternative. It was a simpler time, but the same thing plays out today in String Theory. Those not “in cahouts” can still act like the “philosopher who does not understand something and will take care not to understand anything else whereby it might be explained”, to paraphrase David Lewis. Pilot Wave theory is not taught at most schools, and those interested in it are looked at suspiciously, still. As Holland says, “with hindsight we can now see how impractical, inhibiting ideas came to dominate and distort the entire development of quantum theory. The early quantum

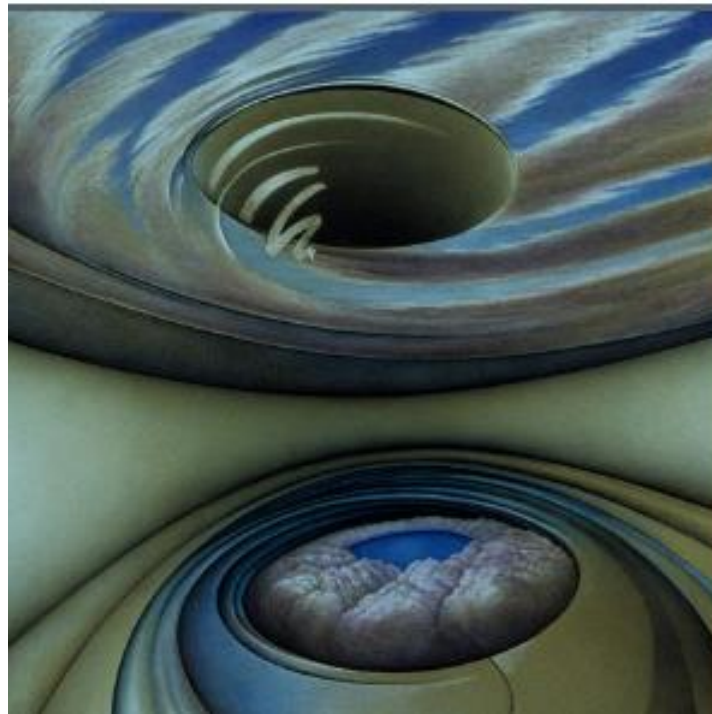
physicists attributed to nature a limitation we can now see was simply a deficiency of contemporary thought.” They called it a Hidden variables theory, as an epithet, when its main driver is position, not very well hidden, as opposed to the QM wavefunction, which is nowhere in sight. Bell again: “... in physics the only observations we must consider are position observations, if only positions of instrument pointers. It is a great merit of the de Broglie-Bohm picture to force us to consider this fact.” “That X rather than Ψ is historically called a ‘hidden’ variable is a piece of historical silliness”.

The essence of the theory is a “dualist representation by corpuscles and associated waves” which “allows us now to see the non-relativistic quantum theory as just statistical mechanics with a different (quantum) dynamics”, in De Broglie’s words at Solvay. Bohm added multi-particle interactions later, and Nikolic and other have recently extended the theory to relativistic QM. The wave appears as both a pilot wave and as a probability wave, giving the same results as QM does (a plus, given the experimental support of QM). It explains atomic transitions without the need for random “jumps”, and, using a quantum potential term, provides the classical $F=ma$ dynamics.



The theory preserves the distribution of particles in time (equivariance). It calculates a probability of “presence”, not “measurement”, since it assumes the particle “is” somewhere already. It implies the principle of least action for the particle aspect, and Fermat identical quantization conditions (and hence least-time for the wave aspect) appear in a natural way. Schroedinger identified the particles with localized wave packets.

The theory plays into our PL fluid world model, where the phase space representation of the wavefunction is carried by Pilot PLs. Bohm eventually espoused a “hidden world”, an “implicate order” (derived from Hindu Philosophy), where the real world dives regularly before emergence into the “explicate order”, our plane of existence. This diving is described by a process of enfolding and unfolding (translated into Green’s Function). This deeper level is our “Netherworld”, and the wavefunction is a manifestation of this deeper level, this Netherworld.



The velocity of a particle is interpreted as the actual velocity field of an “ensemble”. Objectively existing “particles” or photons can also be real fields (Electromagnetic waves of PL fluid in our proposal), with the Pilot wavefunction guiding those real fields, with a “field ontology” assigned to bosons (like photons, which are clearly EM fields), and a “particle ontology” for fermions (which we are also interpreting here as trapped photons, hence

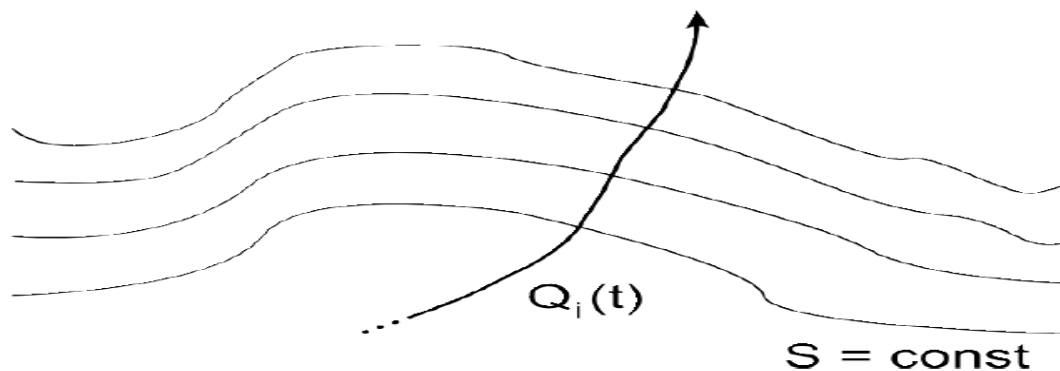
also EM or color fields). Hence Quantum Field Theory (QFT) can still be used to “mathematically” describe those particles’ behaviour, while assigning to them a reality never-the-less.

Such an interpretation of the guiding wave is much more conservative and intuitive than the bizarre Many-Worlds interpretation, where every wavefunction action results in a whole new Universe – a severe case of believing one’s mathematics to the degree of extravagance in assigning a reality to it, while denying the reality of what our senses show. In our scenario, the wavepackets are real, consisting of PLs, driven by correlations in “configuration space”, our “Hilbert Space”, yet still tied to the “corpuscle” core configuration which represents the particle. Those Pilot PL waves represent possible mathematical options for the particle motion, while the one “real” path realized is the one actually taken by the packets containing the actual PL bulk, which are driven in a single world relating to their existence plane.

Time, an ill defined quantity in QM, is then measured by the interactions of those real particles, using the 3-D “space” positions defined by their inter-relationship, and the actual “counting” mechanisms of clocks created by their interactions. Without this causal “physical” realization, time could not even be defined to be later applied to the wavefunction. If spacetime is an emergent quantity, it can only be used to describe the behaviour of matter when sufficient contact relationships (interactions) exist in the process under study. We can only say which slit a particle comes through if the particle has sufficient contact relationships with other matter to define position with respect to the slits.

This proposal also gives meaning to the definition of “probability”. When you say probability, the immediate question is: “probability of what?” So if the particle did not exist, you need not worry about its probability anywhere. Instead, the PL pilot wave (or De Broglie Pilot wave) represents a “probability current” which guides – pushes the particle along a determined path, the particle following the “highest probability” path normally – “the analogue of optical multiple refraction, the particle is dragged one way or another depending only on its initial position” (Bell). We have already seen how the “curvature” of space (itself guided by the PL density) would form and guide those PL Pilot waves which then guide the particle. The entire structure then becomes coherent: PL densities in multiple “dimensions” creating the “space

curvature” that directs the flow of “forces” (collimated Pilot waves) that guide the motion of the actual PL Clusters (particles).



The Pilot waves form part of the “Quantum Potential” of the Bohm- De Broglie theory, and this Potential is throughout space, emanating from the particle, guiding it, and at the same time explaining the “non-local” aspect of the behavior, since the extension of the particle is not localized. Distant particles are entangled by this permeating Quantum potential, and the interaction of those QP tails is what provides the entanglement. The Quantum potential has information about the whole space it exists in, and hence knows if there are one or two slits, etc, the same way the QM wavefunction contains the information about the particle. Hiley has explained how this information is distributed to each path depending on the configuration of the slits. This Bohmian system does have a preferred inertial system, but that system is built up by it as it interacts with adjacent particles, in totality framing our Universe.

This model makes sense finally of the wave/particle duality, by providing both aspects in one model. The particles have an objective existence, travel along trajectories, guided by the waves, and this removes the paradoxes of the measurement problem, wave collapse, and observation. It provides a mathematical tool similar to Feynman’s Path Integrals approach or sum-over-histories approach, allowing us to get results that match QM experimental data. It becomes possible to “visualize” the action, and the classical world emerges out of this picture, instead of being a mysteriously pre-existent entity in QM measurement. True, part of the “reality” it pre-supposes is not the usual type of rocks and metal (Pilot waves, being “real” fields which influence “real” particles’ trajectories, and our PL logical entity a case in point), but how else without this novel feature did we expect such a complicated world to arise? By postulating this simple micro-world picture, we open the door to the greater

complexity that interaction (and chaos) can give rise to in the macroworld picture.

De Broglie suggested “a freely moving body follows a trajectory that is orthogonal to the surfaces of an associated guiding wave”, the particles being “pushed” along trajectories perpendicular to wave surfaces of constant phase, like champion surfers. The system has a wavefunction (de Broglie’s idea, not Schroedinger’s) and definite particle configurations and positions at all times. The velocity vector defines the trajectory, and this is deduced from the “probability current density vector” of the wavefunction. In this sense, the “probability” is seen as a fluid, realized in our PI world by the PL Pilot wave PL “gas”, which satisfies the QM equation. This semantic change in the meaning of probability gives the theory its explanatory power. The mirror image operators in Hilbert space are the mathematical representations that drive the configuration of this Universe.

“Note that in this theory probability enters once only, in connection with initial conditions, as in classical statistical mechanics. Thereafter the joint evolution of Ψ and X is perfectly deterministic. ...in this theory the wavefunction Ψ has the role of a physically real field, as real here as Maxwell’s fields were for Maxwell. Quantum mechanics students sometimes have difficulty with the fact that in the pilot wave picture the particle position X and the argument of the wavefunction x are separate variables. But the situation, in this respect, is just that of Maxwell. He also had fields extending over space, and particles located at particular points. ... Although Ψ is a real field it does not show up immediately in the result of a single ‘measurement’, but only in the statistics of many such results. It is the de Broglie-Bohm variable X that shows up immediately each time.” And hence the irony of the name “Hidden variable theory”.

The theory results in a modified Hamilton-Jacobi theory that is similar to the Hamilton-Jacobi theory which is the basis of classical mechanics, adding a “Quantum Potential” (QP) term to it. Classical mechanics emerges naturally as the limit, while the QP guarantees agreement with QM results. The effective collapse of a subsystem’s wavefunction comes out naturally, gradually, independent of sentient observers (who were not there at the big bang and throughout most of history; we can also let God rest instead of observing

every little particle in the Universe!). Measurement paradoxes like Schroedinger's cat and Wigner's friend disappear.

The uncertainty principle comes out as a byproduct of the uncertainty in the "position" of a particle, that particle not being a point object, but an extended wave packet, whose "position" is bound to be within the limits of its size. This is a defect in QM that tries to pin an "observable value" on an incompatible QM entity, something Einstein warned Heisenberg about early on: "Your theory will one day get you into hot water", because "when it comes to observation, you behave as if everything can be left as it was, that is, as if you could use the old descriptive language". The momentum uncertainty similarly derives from the uncertainty in position, on which it depends for velocity measurement.

Entanglement comes out from the structure of QM and the wavefunction in configuration space, which is over all space. Since those functions are in the entire configuration/phase space, when entangled they can effect instantaneous changes in the waves that guide particle behavior (note in our model PLs can move instantly between locations, unlimited by the speed of light as they emerge from the Netherworld). In a sense, this "wave function" provides a background for a universal simultaneity, a True Time in the configuration space, while our malleable space-time is an artifact of the 3-D presentation of the particle driven by that wave, giving the semblance of non-locality in certain aspects. Bohm himself used an analogy to a hologram making an image, recognizing our limited 3-D Cartesian perspective is insufficient to support the non-local action.

Bohm's hologram image is a reflection of our PL picture, with the hologram driven from the Netherworld, his "Implicate" world, and the object we see (image) being the "explicate" world. The Hologram is not a copy of the object, but a suitable configuration that drives the generation of the object in the explicate world. This "Undivided wholeness in flowing movement" implies the order of the whole universe is enfolded in the implicate world. From a configuration space perspective, this is mathematically implicit in Green's function and the wave structure – "the non-commutative algebra is the implicate order... each measurement makes manifest or explicates an eigenvalue that was enfolded in the algebra of operators" (Hiley).

The non-locality is reinforced by the De Broglie waves, which imply a dependence of each particle on the trajectory of all other particles, with the

one responding to ALL, and the All responding to one, with true action-at-a-distance.

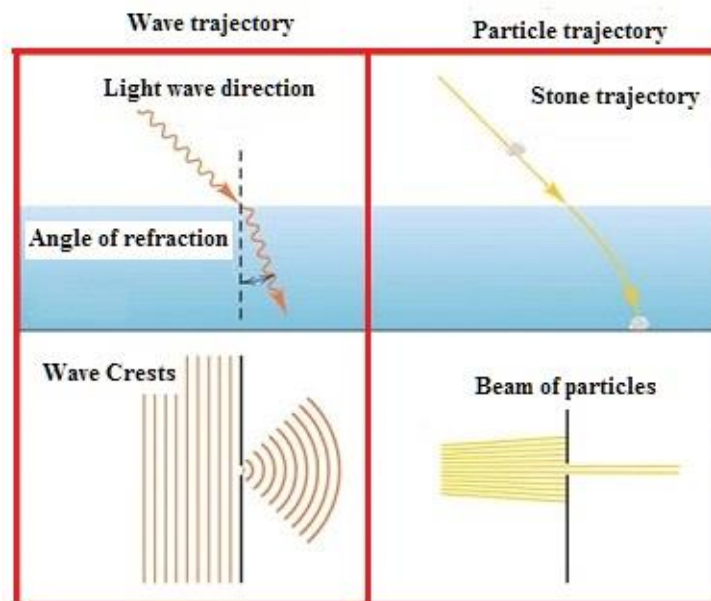
The theory makes use of the fundamental Hamilton-Jacobi relations, and in preserving conservation of energy assures the field is “divergence” free, acting as an incompressible fluid and maintaining particle cohesion, while the phase space being transported by the Hamiltonian flow remains unchanged (Liouville’s theorem, the basis of classical statistical mechanics). This analogy to classical concepts ensures the theory ultimately approximates a classical world in the quantum limit.

The effects of spreading are counter-acted by interaction with the environment (decoherence), and the wavepacket remains localized, approximating classical theory. In this respect, I propose that fermions have a stricter localization, due to their resonant structure – the photon loops stable at a particular configuration, which is why an electron is an electron is an electron. Bosons (e.g. photons) are inherently free propagations of EM radiation, and hence less structured, which is why a free photon can have many energies and sizes. The effects of spreading of a photon, in isolation in millions of years of travel, would be demonstrated in diffusion and reduced “energy” in the photon, as PLs are lost producing “tired light”. The Structure of the Q quantum potential for Bosons is symmetric, while fermions are anti-symmetric, and the topology of their configuration space and their correlations are different. The anti-symmetry of fermions implies Pauli’s exclusion principle (two fermions cannot occupy the same 3-D space point at the same time – i.e. are “impenetrable” (Ehrenfest)), which drives much of chemistry (Hund’s rule, etc). Bosons are not so restricted (they are “penetrable”), & this distinction was noted early by Einstein who thought that the differences “express indirectly a certain hypothesis on a mutual influence of the molecules which for the time being is of a quite mysterious nature”.

The theory, in postulating the phase of the wave function as the generator of trajectories of particles provides a reasonable model of the velocity field relating to the density current vector, with particles following stream lines of probability flow, a hydrodynamic analogy that fits well with our PL Fluid model. Its further use of standard symmetry laws, conservation laws, and the classical Hamilton-Jacobi approach further consolidates its status as “within experimental and classical limits”.

Like our PL picture, the full individual system lives in a multi-dimensional (configuration) space, with the particles “moving” in an emanent 3-D space, the additional dimensions critical to explaining the superposition and entanglement aspects. While some (like Pauli (God’s Whip!), who I think “isn’t even wrong” in this case ☺) think of the configuration space as a mathematical tool, our proposal confirms its ontological status, as a part and parcel of the logically constructed existence space.

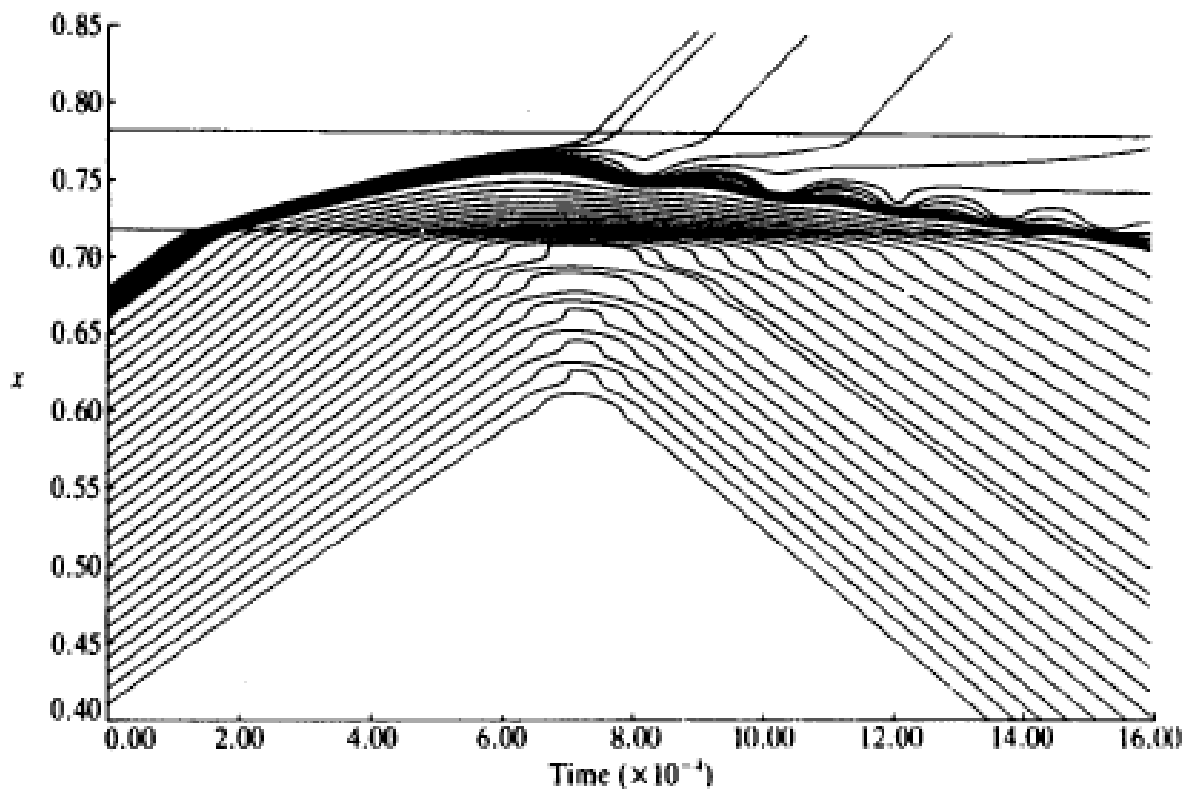
This new concept brings a merger between wave and particle characteristics, explaining the wave/particle duality, with coherent “mass” “points” (or configurations/wavepackets) moving and interacting under the influence of the extended influence of the wave and the quantum potential. This wave and quantum potential ties the “particle” to the entire space, and brings about a united reality in configuration space.



The wave in question is not a “radiated” wave, but an “associated” wave. Its value is in its information, not in its intensity. It does not carry energy of the particle (yet it has its own energy, momentum and angular momentum – in our proposal being made of PLs itself), but carries phase information that guides the particle. It is a separate “entity” from the particle, yet integrated with it. Wave-Particle duality is explained very simply: both particles AND waves co-exist.

Probability arises out of the uncertainty of initial conditions that are not known precisely. In fact, given the emanent structure of spacetime, which only coheres through eventual interaction, and given the quantization of space, that information may even be unknowable in principle, even though future evolution of the wave is deterministic.

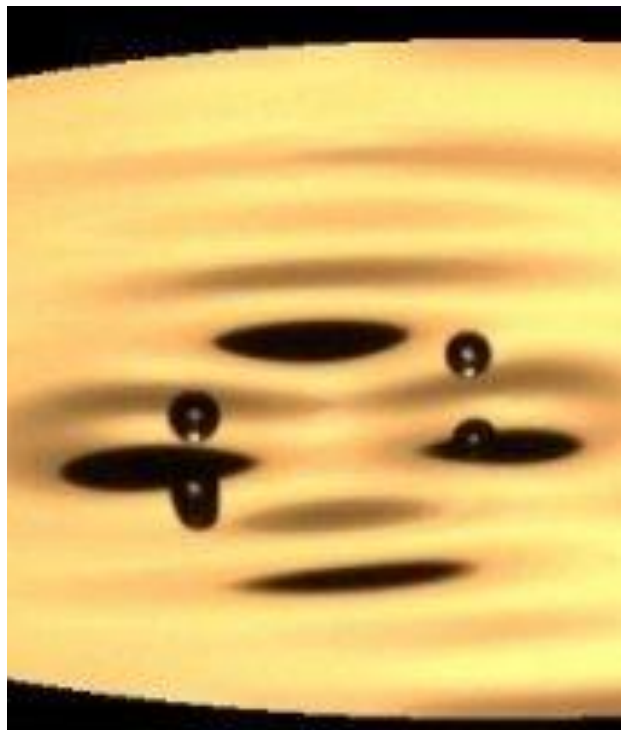
Uncertainty, a-la-Heisenberg, is a confusing and confused subject. If we know momentum exactly (somehow), Heisenberg says the position is completely unknowable and even meaningless. Meaningless how? Where is this thing whose momentum we have EXACTLY measured? Heisenberg: that question is meaningless. Why? ... A more meaningful approach would take one of several routes – wave packets have a certain extension in space, and that provides an uncertainty in position; Single isolated particles have “undefined” position and momentum because they are in their own spacetime bubble until they interact with other particles (see Reality below); uncertainty due to varying initial conditions of ensemble particles, resulting in various probabilities of detection at x & p .



Tunneling effects are similarly derivable from the Pilot wave trajectories, where certain paths lead across a barrier, depending on initial conditions in

an ensemble. While some guide waves are reflected, other are transmitted, and guide the particle across the barrier. Similarly, the Aharanov-Bohm effect reflects the fact that the guide wave carries information (about the magnetic field, which is in this case the “particle”) even where the actual field strength itself is zero.

Interference effects like slit experiments are ultimately statistical effects of ensemble behaviour of particles guided by the Bohm-De Broglie waves. The detection itself is always of a “particle”, whose presence is negotiated by the “probability” emanating from the pilot waves interference. The pilot waves pass through both slits, but the particle itself eventually takes one of the paths traced by the pilot. The “interference pattern” at the screen is built up over a large ensemble. Clever experiments to find “which way”, while not touching the particle, always touch the wave, and in doing so entangle the wave and change the target trajectory, undoing the interference effects. Even delayed choice experiments do not contradict this, since the action taken (anytime until the particle hits the screen) will still impact the guide wave, and impact the result even if the particle has passed the slit, since the guide wave action is instantaneous and not tied to the 3-D speed limit of lightspeed.

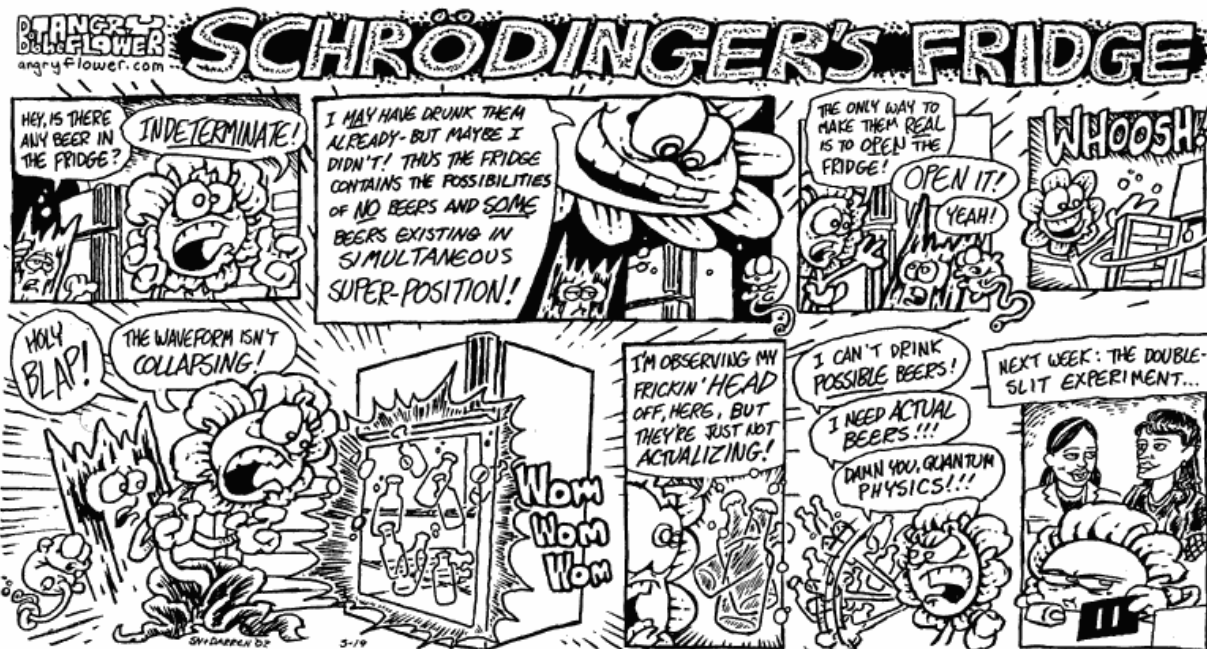


Recent experiments at Imperial College on vibrating fluid surfaces show similar effects at the macroscale, where “guiding waves” equivalents result in

interference and similar quantum effects, which point to a hydro-dynamic aspect of guiding waves, that are being used to extrapolate into the quantum realm.

The measurement problem of QM, stemming from assuming a classical background (leading to an undefinable division between the micro and macro worlds) requires postulating a non-local collapse of the wavefunction unexplained by the Schroedinger equation and somehow initiated by “observation”. As Durr and Teufel iterate, “most of what can be measured is not real and most of what is real cannot be measured, position being the exception”. Bell restates the problem of QM (solved by pilot waves) as: “the problem of measurement and the observer is the problem of where the measurement begins and ends. I think that – when you analyze this language that physicists have fallen into, that physics is about the results of observation – you find that on analysis it evaporates, and nothing very clear is being said.” The conundrum is likened to the “difference between a shaky or out-of-focus photograph and a snapshot of clouds and fog banks” (Schroedinger). Towler compares the “observer” dependence to the Wile E. Coyote falling only once he notices that he is running in mid-air ☺. Greene compares it to “Lucille claiming she is a blond – until someone looks, when she immediately transforms into a redhead”.





The Pilot wave theory solves the “measurement problem” of QM by simply doing away with it and with the observer. John Bell, that genius who decorated our world in the 60’s and 70’s, before his early demise in the 80’s, suggested: “In particular we will exclude the notion of “observable” in favor of that of “beable”, the **“beables”** being those elements of the theory which correspond to elements of reality, things that exist”. For a theory providing a picturable ontological view of the world, the beable is the decisive factor. For John Bell, giving up locality is preferable to giving up reality.

Field Beables for bosons, and particle beables for Fermions are proposed. The picture is clear for the boson (like EM field), but for fermion several approaches were proposed, including one where the beables for Fermions are the field interactions and the electron or Fermion as epiphenomenon (which rhymes with our approach of Fermions being EM packets). John Bell suggested Fermion numbers as the beable, those numbers intimately related to its configuration. Bell also regarded the state vector as a beable, “although not a local one” (responsible partly for the action at a distance). The probabilities calculated then are those for the “beable” to “be” in a particular state, and not just to be “observed” in that state. No need for a “measurement Postulate”, and William of Ockham’s “Entia non sunt multiplicanda praeter necessitatem” applies. Meanwhile, the “vacuum” is defined to be the state with no beable-particles.

Relativistic generalizations of the theory used multiple approaches, including “preferred slicing of space-time”, as well as separate time for each particle (our PL view of an isolated cluster). Those approaches accommodate the theory to relativity (a key requirement), including the Michelson-Morley experiment (per John Bell, the author of the “most profound discovery of Science”, and what John says goes around here ☺), restoring Lorentz invariance. This symmetry property that leads to the laws of physics being the same for all observers is a key property of spacetime that follows (or leads to) special relativity. The preferred slices of spacetime chosen presume a Universal time, unlike special relativity, but as we have indicated elsewhere, Lorentz transformations allow for such a reference frame, and give identical results to Special relativity – it is simply an “interpretation” issue which view to take. “Many students never realize, it seems to me, that this primitive attitude, admitting a special system of reference which is experimentally inaccessible, is consistent... if unsophisticated” (Bell).

Special relativity is proven, but its interpretation using Minkowski spacetime (adopted by Einstein later) is not provable – Popper (on contemplating non-locality, also proven) suggests “we have to give up Einstein’s (*really Minkowski’s*) interpretation of special relativity and return to Lorentz’s interpretation, and with it to absolute space and time. The reason for this assertion is that the mere existence of an infinite velocity (*non-locality*) entails the existence of an absolute simultaneity and thereby of an absolute space. Whether or not a infinite velocity can be attained in the transmission of signals is irrelevant for this argument: the one inertial system for which Einsteinian simultaneity coincides with absolute simultaneity... would be the system at absolute rest – whether or not this system of absolute rest can be experimentally identified.” This does not mean that the inertial system cannot be “warped”, or evolve with time, as our PL proposal assumes. This is necessary not just for pilot wave approaches, but also for most decoherence proposals (like GRW) where the collapse is instantaneous. The Ether needed for this space is our PL space mesh, where PL motion can be “instantaneous”, providing non-locality, and defining the preferred frame. The apparent (and verified by measurement) variations in time and space can be explained by Lorentz contraction, and the effects on the actual systems (rulers, clocks) themselves. With the systems made of EM fields, this is quite feasible, and many proposals for how this comes about are put forward. Simultaneity is not relative, even if hard to pin down.

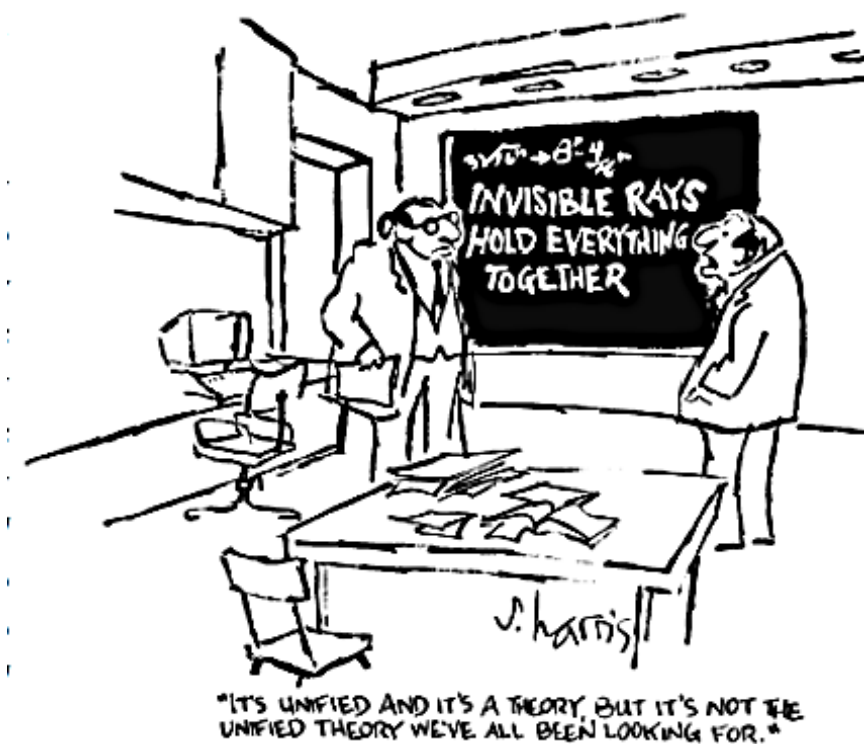
Bell, in pondering this problem, suggests “the cheapest resolution is something like going back to relativity as it was before Einstein, when people like Lorentz and Poincare thought that there was an ether – a preferred frame of reference- but that our measuring instruments were distorted by motion in such a way that we could not detect motion through the Ether.” i.e. local effects in the ether (space-mesh) on the particles simulate the effects of special relativity, and are coherent arguments not inconsistent with it. “The reason I want to go back to the idea of an ether here is because in these EPR experiments there is the suggestion that behind the scenes something is going faster than light.” Quentin Smith advocates “a radical rethinking of quantum gravity: rejecting Einstein’s (*Minkowski’s*) relativity (*interpretation*) and unifying Bohmian Quantum Mechanics with a Bell-neo-Lorenzian absolute time, space and gravity.”

This view is increasingly being echoed by physicists today, reconsidering the Lorentz approach in view of the confirmation of non-locality. Quantum non-locality defines an absolute 3+1 slicing of space-time, leading us back to a more natural view that the world is a single 3D spatially-extended reality capable of warping and changing as a function of a “standard” time (albeit one that can be measured to be variable locally as a result of Lorenzian effects). Only such a structure can preserve causality. The Galilean transformations of additive velocities do not apply because spatial effects of motion produce contractions (a Doppler like effect on EM waves undergoing distortion in motion), with the speed of light being the “reference” speed for EM, “assumed” as fixed, and therefore showing up as such to all observers. This also removes the bizarre non-intuitive aspect of the fixed speed of light in all frames. All of this does not affect the view of General relativity, where fields can distort the space mesh (our PL “dimensions” of the fields) resulting in warped or curved geometry driving the dynamics of interaction.

The theory is also NOT a “hidden-variables” theory, since the key “observable” is position, which is not hidden at all, and represents real coordinates, not a Quantum operator. Other QM “Operators” like momentum, Energy, etc which are derivable from position (and velocity) are given secondary status (this is relevant in our PL model, since particle configurations are key to those secondary items, the particles not being points but have a dynamic behaviour of their own). Those secondary properties such as spin and energy are “contextual” properties that vary with the experimental setup (hence

circumventing the Kocher-Specker “no-go” theorem). Only position and momentum (tied to velocity) are the basic parameters of the theory. The confusion of QM operators and insisting on them as measurable eigenstates that are incompatible simply disappears.

Quantum jumps are also relegated to continuous, timed (albeit short) events resulting from the guide waves moving the particle from one position to another (with corresponding energy change) smoothly and predictably, as the incident “particle” (say energetic electron or photon) gradually interacts with the existing Pilot fields, and creates a new structure which guides all the new components of the ensemble to their final steady state, with the evolution described by the time-continuous wave equation, and no mysterious abrupt jumps involved. The individual starting and end states would be states that form stable configurations of matter and particles, but the intermediate states are a smooth timed transition guided by the wave-function, something we have verified in measuring emission times of photons.



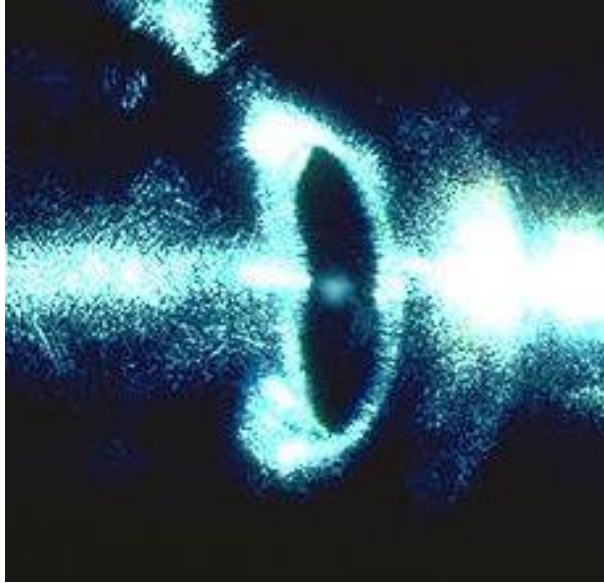
The theory duplicates the results of QM, assuring it works as a FAPP (For All Practical Purposes – Bell’s favorite term) theory, but has the advantage of clarity and ontological status, something the Copenhagen Mumbo-Jumbo was allergic to. The probabilistic aspect of QM is calculated, instead of being

postulated (without proof) as Born's assertion normally is. It gives an observer-independent view of the world (so the world will continue to decohere on Sundays when God is resting ☺), and the electron can still move when we are not measuring it (so we can take weekends off too!). This author-beable likes it.

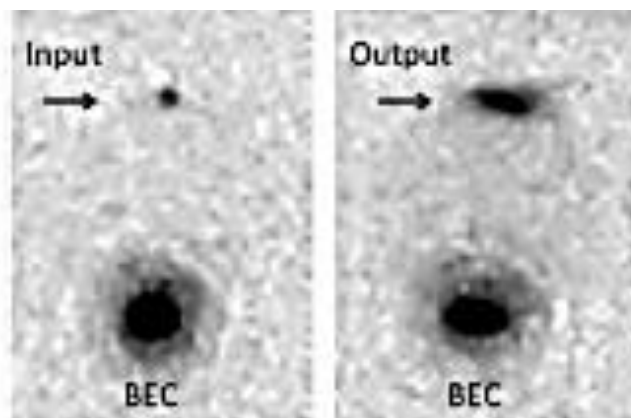
The Hydro-dynamic aspect of the probability density and its flow in configuration space strengthens the link to our PL Fluid model, with the wave equation representing a set of chunks of "probability fluid", our PLs guiding the flow, with the quantum potential the source of the quantum effects in the dynamics – equivalent to "quantum stresses" in the fluid. The end result is a quantum hydrodynamic equation of motion. The global wavefunction produces non-locality, since the trajectory is "aware" of the function in surrounding regions as a result of the density amplitude "curvature" and the phase "curvature", again geometry in play. The "particle" aspect then presumes the appearance of "quantized vortices" in the fluid, as in our PL model.

The theory does not address the internal structure of the particle, or how it is formed. Our PL proposal addresses this separately, by conceiving of a PL fluid creating EM structures that form photons, both free and trapped (matter). Visualizing the guiding wave as part of the PL fluid further strengthens the unity presented by nature, its economy displayed in using that "bit" logical entity to create "it", as Wheeler would say.

Our world does exist. We can now see it at the microscopic level, using technology developed, ironically, from the mysteries of QM which denied it. The electron and positron, which Heisenberg insisted had no path or was not there until we looked (a position he somewhat backtracked on later in life, calling for a renewed search for the dynamical laws governing particle structure), has been "captured". Hans Dehmelt (Nobel Laureate, 1989) "trapped" a positron he affectionately called Priscilla and held it for three months (I always thought of electrons as female, positron as male, but apparently I was wrong ☺). The magnetic moment of an electron which Bohr and Pauli thought "we must conclude that it is meaningless to assign to the free electron" is now measured repeatedly, to an accuracy of 12 digits. Dehmelt (the nemesis of the micro world) trapped a single barium atom (he also called Astrid) for ten months, and took photographs of her repeatedly!



“Perhaps the most convincing proof of the reality of the quantum world would be to capture some of its creatures and hold them in place for all to see. This has become feasible.” [Ho-Kim et al.]. Clear evidence for wave field existence has come from matter wave optics. Ultracold atomic gases have a dominant wave behavior which we can manipulate by ‘optical devices’. Significant quantities of matter can be diffracted, focussed, reflected etc. Also ‘matter wave amplification’ experiments have been performed: production of an output of atoms with particular properties from a BEC (Bose-Einstein Condensate) reservoir of atoms in a trap using a process similar to stimulated emission of light in a laser. If matter waves can be subjected to and utilized in such a process, it logically follows matter wave must exist in order to act and be acted upon. Matter waves, a form of pilot waves, EXIST.



So much for Heisenberg’s “The idea of an objective real world whose smallest parts exist objectively in the same sense as stones or trees exist,

independently of whether or not we observe them... is impossible." Well, at least he was right about the stones and the trees ☺. Von Neumann's "impossibility proofs" notwithstanding (disproved by Grete Hermann as early as 1935, and later by Bell in 1966), an electron can have a trajectory. Schroedinger said "Complementarity is a thoughtless slogan. If I were not thoroughly convinced that the man (Bohr) is honest and really believes in the relevance of his – I do not say theory but – sounding word, I would call it intellectually wicked." Einstein more kindly said this is all "to be ascribed to the fact that this theory operates with an incomplete description of physical systems."

While "Bohr brainwashed a whole generation of physicists into believing that the problem had been solved" (Murray Gell-Mann), John Bell "saw the impossible done. It was in papers by David Bohm. Bohm showed explicitly how parameters could indeed be introduced, into nonrelativistic wave mechanics, with the help of which the indeterministic description could be transformed into a deterministic one. More importantly, in my opinion, the subjectivity of the orthodox version, the necessary reference to the 'observer', could be eliminated". He started a roll when he wondered "why then had Born not told me of this "pilot wave"? If only to point out what was wrong with it? Why did von Neumann not consider it? More extraordinarily, why did people go on producing 'impossibility' proof, after 1952 and as recently as 1978? When even Pauli, Rosenfeld, and Heisenberg could produce no more devastating criticism of Bohm's version than to brand it as 'metaphysical' and 'ideological'?... Why is the Pilot wave picture ignored in text books? Should it not be taught, not as the only way, but as an antidote to the prevailing complacency? To show us that vagueness, subjectivity, and indeterminism, are not forced on us by experimental facts, but by a deliberate theoretical choice?" The rebellion is now afoot. Attempts at counter-rebellion, like Many Worlds and Many Minds, are "more like the death rattle of a collapsing radical idea than the foundation of a viable theory of natural reality." (Stapp)

The Quantum Force that helps guide the particles is a new guise for a "Fifth Force", similar to the four basic "forces". However, on further analysis, all these forces are manifestations of geometric warps in the field, and therefore not "forces" as such (which only exist as an interim concept). The reality of this Quantum force is displayed in explanations of the Pauli force/repulsion of the exclusion principle, electron degeneracy pressure in collapsing stars, and

other applications, where its action (including distant action, undiminished, a-la-gluon strong force) is displayed.

But Physicists did not follow this thread. Instead, they decided to “take a board of wood, look for its thinnest part and drill a great number of holes where drilling was easy” (Einstein). Roland Omnes described the repeated dogma of the Copenhagen clique as “reprints of original articles or learned commentaries, becoming more and more commentaries upon commentaries as time went on”, something that brings to mind theological theories rather than Scientific ones. As Peter Holland says in a review of “The Strange World of Quantum Mechanics” (Daniel Styer): “I wonder what Styer’s student readership would have thought had he reproduced the iconic figure of Bohm’s trajectories for the two slit experiment. My experience is that they would have asked why this model isn’t fully explained in books such as this one, and, indeed, why it isn’t the “standard view”. To be sure, Bohm’s theory has unresolved problems (fertile theories do). But the point is that it allows one to analyze how the black box functions through a causally connected sequence of events from input to output. As probability is no longer the basic concept, this view is more complete than the standard one, with no need to invoke images of “shimmering colors” when referring to electrons. Surely students should be told of this. ... If you are looking for an original account of Feynman’s approach, I recommend this book. But surely the weirdness card has been played enough by now – isn’t it time to do it differently?”

Vive la Difference

“If the Universe is not the way Bohm describes it, it ought to be.”

- John Briggs and F. David Peat

“You are not thinking. You are merely being Logical!”

- Niels Bohr, to Albert Einstein (in exasperation ☺)

“Bohmian mechanics is empirically equivalent to orthodox quantum theory.”

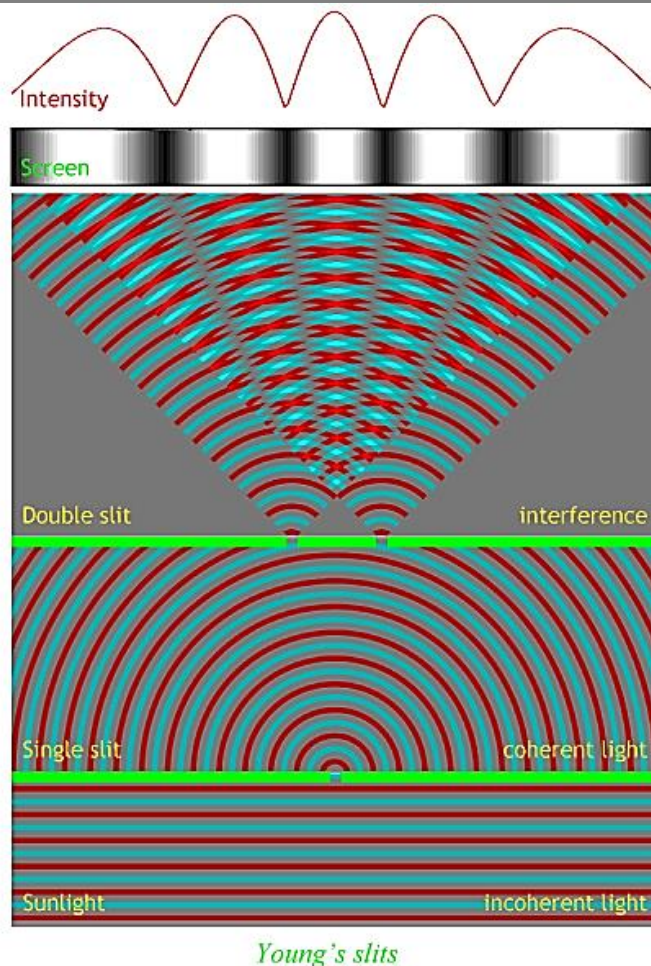
- Sheldon Goldstein

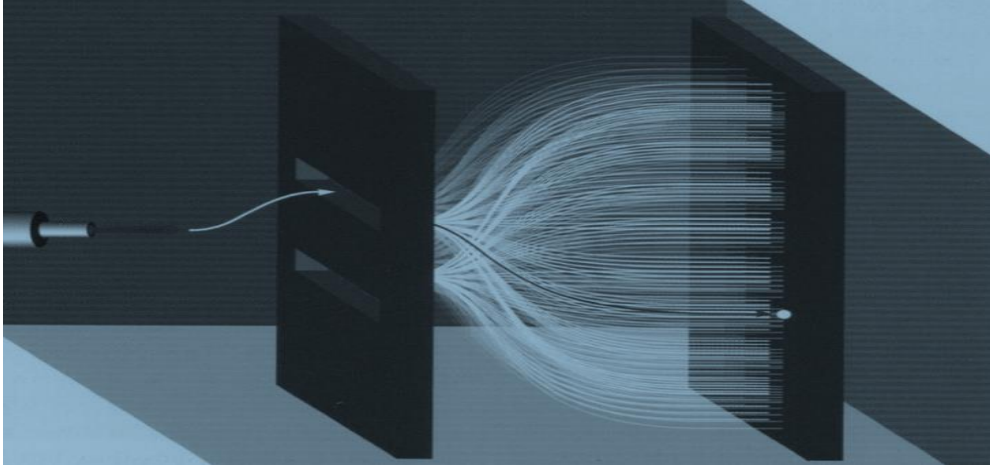
“What we observe is not nature itself, but nature exposed to our method of questioning.”

— Werner Heisenberg

“In a theory in which parameters are added to quantum mechanics to determine the results of individual measurements, without changing the statistical predictions, there must be a mechanism whereby the setting of one measuring device can influence the reading of another instrument, however remote. Moreover, the signal involved must propagate instantaneously.”

— John Stewart Bell (1964)





One real particle, a complex Guide Wave

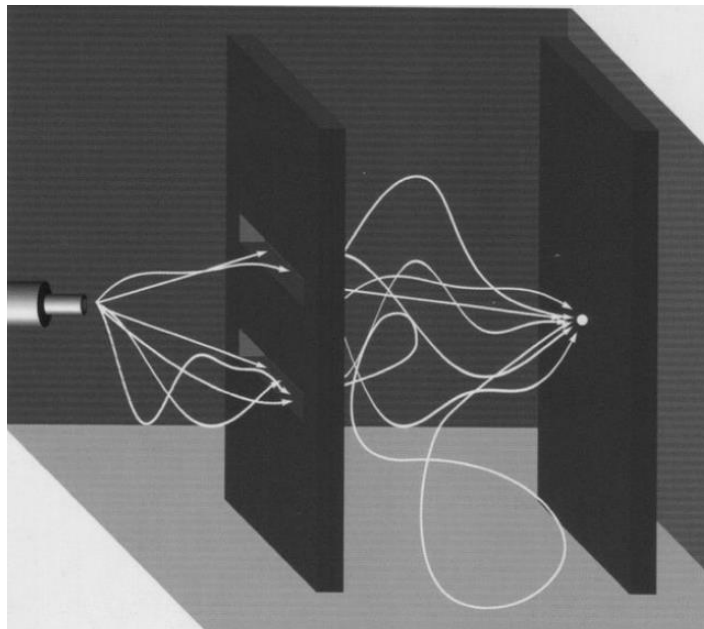
Heisenberg's main (only) criticism of Bohm's ideas: it is metaphysical and ideological. This from the prophet of Copenhagen. Enough said.

Jim Cushing's view is that the main reason the Copenhagen interpretation is regarded as the standard one is because it came along first and was advocated by stronger personalities. David Mermin, in an effort to counter John Bell's views (which he initially advocated), retorted that "what is proved by possibility proofs (of hidden variable theories) is an excess of imagination" – since when has a vivid imagination become a handicap in Science? Was Einstein over-imaginative in coming up with a theory that changed the nature of Space and Time?

"There is nothing ad hoc or artificial about the Bohm flows. They are a necessary structure of the quantum formalism when looked at in terms of the underlying geometry. ... It is a direct consequence of simply rewriting the schrodinger equation in its real and imaginary parts under polar decomposition of the wave function" (Hiley). In fact, "provided we accept the de Broglie matter wave hypothesis", the Schroedinger equation itself "emerges from classical mechanics... for all Hamiltonians" (Hiley).

Many new approaches to the quantum picture vindicate Bohm, even if unwittingly. Murray Gell-Mann's and James Hartle's consistent histories approach, where the particle "explores" all possible paths, similar to Feynman's approach in QED, is an echo of Bohm's approach, where the wave

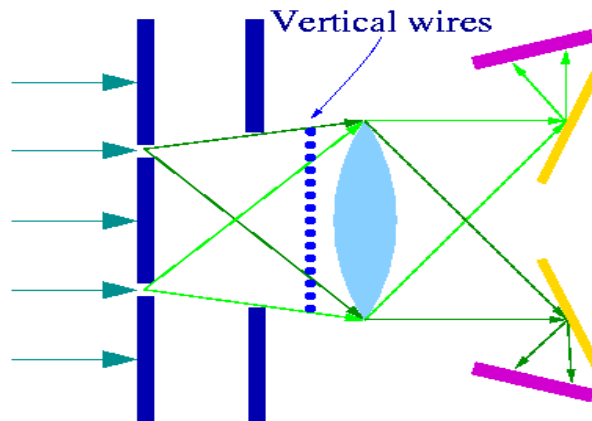
function (which describes the various possible paths, in a non-local fashion, and selects the path for the particle to follow) does the exploring.



Bohm's and De Broglie's theories in fact are bold enough to put non-locality, now a proven concept, up front, and not hidden in the details of EPR experiments. John Bell wanted an equation that determines the path of the particle, and the Pilot wave function provides that. That this function acts non-locally, super-luminally, is explainable in our PL model, where the "Grid" is an instantaneous transmission medium, even while the particles (PL clusters) move at the speed of light or below. Disturbing the quantum potential in one location instantly affects it throughout space, changing the "guiding" principle for the particle instantaneously. Bohm and Bell both argue that, even though this gives a preferred frame of reference, it does not contradict the Special Relativity when it comes to "observable" phenomena.

Bohm suggests the wave function is not just a mathematical curiosity, but a real physical presence (both views being equivalent in a mathematical universe), and this real wave function guides the definite particle. And if we see the "speed" of the wave function as a result of "group velocity", we can see that in the case of photons, this is equal to the wave velocity, the speed of light. Perhaps this is why the wave aspect of light is so manifest, since the physical wave matches the pilot wave, and light can be regarded as both a physical wave as well as a physical particle, depending on how we observe it.

Afshar experiments have demonstrated the possibility of observing both the wave and particle properties of photons simultaneously, confounding the complementarity principle.



Ballentine considers the “wave-duality” a misnomer, initiated as “an unfortunate generalization from a technological limitation” at the birth of Quantum Mechanics. “Today it is possible to detect the arrival of individual electrons, and to see the diffraction pattern emerge as a statistical pattern made up of many small spots (Tonomura et al., 1989). Evidently, quantum particles are indeed particles, but whose behavior is very different from what classical physics would have us to expect.” More recently, M. Cini, generalizing the formalism of classical statistical mechanics in phase space (including an uncertainty and discreteness postulate), sees the wave-particle duality can be interpreted as “reflecting the dual nature of the quantum field as a unique physical entity, objectively existing in ordinary three-dimensional (or four-dimensional, relativistic) space.”

While the wavefunction is real and non-local, it does not conflict with relativity or allow for superluminal communication, since it acts indirectly on the Hamiltonian, which then affects the evolution of the measurable hidden variables. The reality of the wave function is at a different level from the reality of the hidden variables. Bohmian Mechanics, like orthodox QM, is not contradictory with relativity.

The guiding wave terms are analogous in many ways to the force terms of Landau type kinetic equations, “where each particle is subject to an average force proportional to the gradient of the density” (Laloe). While this may seem incidental since we are dealing with one particle, in our PL picture this

particle is a compound of PLs, which each act like a sub-particle, and hence the analogy is closer than it first seems.

Introzzi and Rosetti think Bohmian Mechanics offers a “hidden variables formulation of quantum mechanics that is empirically equivalent to standard quantum mechanics, but offers a more rational and coherent picture of reality.” “Bohm’s interpretation is, both epistemologically and ontologically, a natural extension of classical mechanics to the quantum domain; the visualization of physical processes is still possible, and the corresponding picture of reality is more intuitive.” Lebau lamented “the premature Copenhagen abortion of the developing embryo of the quantum, post-classical revolution.”

Schroedinger himself had indicated that “the Rays, i.e. the orthogonal trajectories of wave surfaces, are therefore the paths of the system for the value E of Energy... a set of system paths can be derived from each special function of action, just like a fluid motion from its velocity potential.” Heisenberg, in his Nobel lecture, agreed with Schroedinger’s view that “the energy-momentum tensor assigned to matter waves can then also be adopted in this theory as consistent components of the formalism”, and that “it is apparently no less correct to compare the atom with a charge cloud”. Born, following Einstein’s idea that the EM field is a kind of “Ghost Field” (gespensterfeld) whose waves served to guide the motion of the corpuscular light quanta, and whose squared wave amplitude reflects the density/probability of the presence of the light quanta, suggested similarly that the square of the wave function is “almost self-understood” as the probability density of particles. Born also used Slater’s Virtual Radiation Field as an equivalent model. We can “regard the particle as following the streamlines of the probability current, an assumption that is actually often made in physical problems in condensed matter physics, particularly in superconductivity problems” (Hiley). Even Heisenberg himself hinted at a “hidden variable” approach: “in the exact formulation of the law of causality that, “If we know the present precisely, we can determine the future”, it is not the consequence but the initial assumption which is wrong. In principle, we cannot determine all the initial conditions of the present.”

Chebotarev writes: “The central idea of the Stochastic Interpretation of Quantum Mechanics consists in treating a microscopic object exhibiting a dual

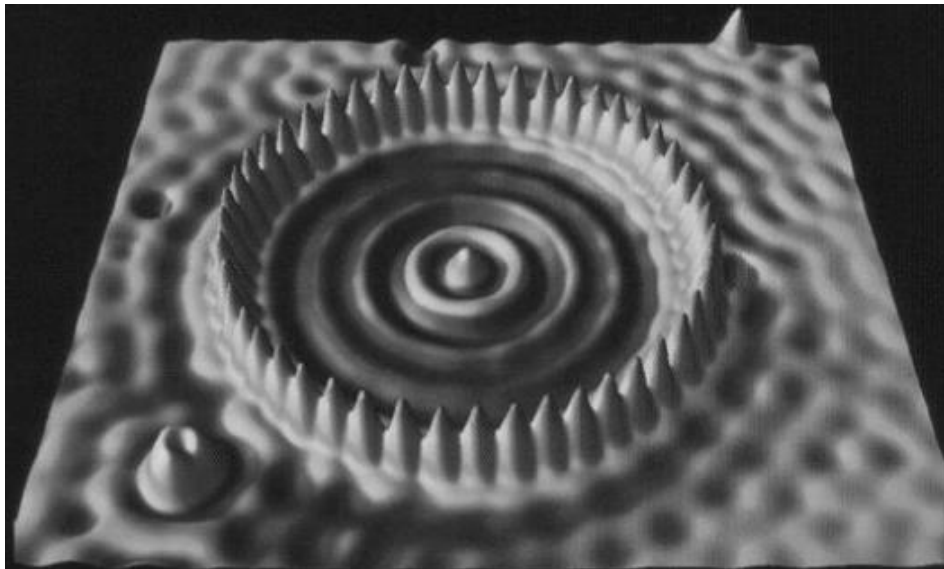
wave-particle nature as composed of a particle in the proper sense of the word (a small region in space with a high concentration of energy), and of an associated wave that guides the particle's motion. Both the particle and the wave are considered to be real, physically observable, and objectively existing entities." He echoes Vigier's view that Particles are pictured as oscillators (or solitons) beating in phase with their surrounding pilot waves, which in turn result from the superposition of superluminal phase waves carried by a subquantal etheric medium subject to constant stochastic fluctuations. The force, or quantum potential, determining particle motions therefore carries information from the entire environment, accounting for the 'wholeness' of quantum phenomena. Recent studies by Dewdney on Neutron interferometry confirm this view.

The non-local aspect of Bohm's view is a strength, not a weakness. Quantum Mechanics requires it, and Bell's theorems & Inequalities have demonstrated it. "... the conversion of potentialities into actualities cannot proceed on the basis of locally available information. If one accepts the usual ideas about how information propagates through space and time, then Bell's theorem shows that the macroscopic responses cannot be independent of far-away causes. This problem is neither resolved nor alleviated by saying that the response is determined by "pure chance". Bell's theorem proves precisely that the determination of the macroscopic response must be "nonchance", at least to the extent of allowing some sort of dependence of this response upon the far away cause." (Stapp).

David Deutsch, in his "The Fabric of Reality" jumps immediately from the mysteries of interference to assuming an infinity of worlds with "shadow" photons and particles interfering with the "real" (in our view) particles, but with nothing else (why?). He then carries that wild assumption, (the only one possible, he insists), into a whole new metaphysics of manyworlds. If he had just looked at the "possibility" of a pilot wave instead of a zillion universes, he would have seen the Occam solution. Sid Deutsch, on the other hand, imagines the wave more realistically as a zero-energy compression shock wave or "wind" in a superfluid Ether forming a Wave-Particle Duality (WPD) field guiding the photon/ particle. Of the two Deutsches, I think Sid is much closer to the truth.

Jim al-Khalili sums it up: "the fact is that there is no knock-down argument which disqualifies the De Broglie-Bohm interpretation, and ultimately every

objection to the approach is based on a predilection for certain sorts of ideas rather than others.” Bohr had declared “Quantum theory is approaching a certain *temporary* completion”. Temporary was right. Bohm’s ideas (like his discovery of re-normalizability ahead of Feynman, Schwinger and Tomonaga, struck down by the caustic Pauli, QM delaying the truth as usual), are not to be lightly discarded. “Like it or lump it, it is perfectly conclusive as a counter example to the idea that vagueness, subjectivity, or indeterminism, are forced on us by the experimental facts covered by non-relativistic quantum mechanics” (Bell).



Eigler’s Iron atoms “Quantum Corral” – A picture of the “Wavefunction”?

“This idea seems to me so natural and simple, to resolve the wave-particle dilemma in such a clear and ordinary way, that it is a great mystery to me that it was so generally ignored”. – J.S. Bell

“... Conventional formulations of quantum theory, and of quantum field theory in particular, are unprofessionally vague and ambiguous. Professional theoretical physicists ought to be able to do better. Bohm has shown us a way”. – J. S. Bell

“In other contexts, physicists have been able to take words from ordinary language and use them as technical terms with no great harm done. Take for example the “strangeness”, “charm”, and “beauty” of elementary particle physics. No one is taken in by this “baby talk”. ... Would that it were so with “measurement”. But in fact the word has had such a damaging effect on the discussion, that I think it should now be banned altogether in quantum mechanics.” – J. S. Bell

“In my opinion, all students should be introduced to it [the pilot-wave picture of de Broglie and Bohm], for it encourages flexibility and precision of thought. In particular,

it illustrates very explicitly Bohr's insight that the result of a 'measurement' does not in general reveal some preexisting property of the 'system', but is a product of both 'system' and 'apparatus'. It seems to me that full appreciation of this would have aborted most of the 'impossibility proofs', and most of 'quantum logic'". – J.S. Bell

"If some historical circumstances had been only slightly different then it would have been very likely that Bohm's deterministic interpretation would have been proposed and accepted first, and would be dominating today." – Hrvoje Nikolic

"For some reason or other, people often object to Bohm for reasons that they would never hold against other interpretations of quantum mechanics." – Craig Callender

"If Bohm's physics, or one similar to it, should become the main thrust of physics in the future, the dances of the East and West would blend in exquisite harmony." – Gary Zukav, "The Dancing Wu Li Masters"

"I wish to represent to myself the union of waves and particles in a concrete fashion, the particle being a little localized object incorporated in the structure of a propagating wave." – Louis de Broglie

"Do the particles actually travel along such paths? I don't know, but in the absence of any information to the contrary, I am quite happy to imagine they do". – Hiley

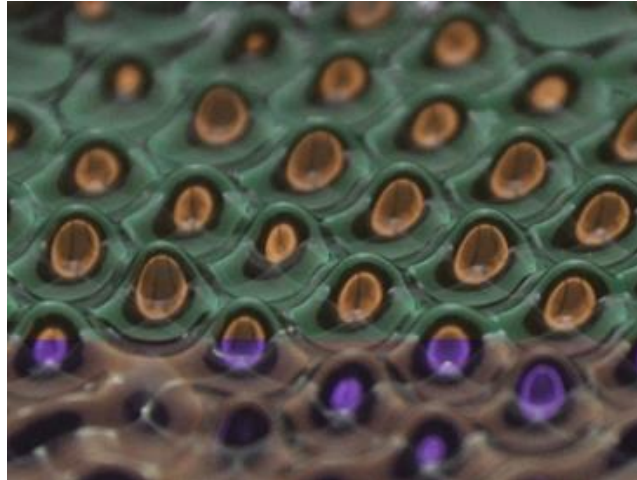
"I had been brought up on standard quantum mechanics and I was asked to [believe] that 'particles sometimes behaved like waves and sometimes like particles'. There was a 'measurement' problem; there were schizophrenic cats, which I am told makes Stephan Hawking reach for his gun! (exactly who/what he intends to shoot is not clear!) Wigner had some trouble with his friend and we were told that "no phenomenon was a phenomenon until it was an observed phenomenon". To some one who enjoyed the tales of Alice in Wonderland, this was great stuff, but rational physics--?" – Hiley

*"the waves in configuration space (or the "transformation matrices") are probability waves in the usual interpretation, while the three-dimensional matter waves or radiation waves are not. The latter have just as much and just as little "reality" as the particles; they have no direct connection with probability waves but have a continuous density of energy and momentum, like an electromagnetic field in Maxwell's theory".
- Heisenberg*

Can fluid dynamics offer insights into quantum mechanics?

Experiments in which fluid droplets mimic the odd behavior of subatomic particles recall an abandoned interpretation of quantum mechanics.

Larry Hardesty, MIT News Office



Vibrating a tray of silicone oil causes so-called Faraday waves to form in the oil's surface. Recent experiments in which fluid droplets reproduce the behavior of subatomic particles require holding the intensity of the vibrations just below the Faraday-wave threshold.

In the first decades of the 20th century, physicists hotly debated how to make sense of the strange phenomena of quantum mechanics, such as the tendency of subatomic particles to behave like both particles and waves. One early theory, called pilot-wave theory, proposed that moving particles are borne along on some type of quantum wave, like driftwood on the tide. But this theory ultimately gave way to the so-called Copenhagen interpretation, which gets rid of the carrier wave, but with it the intuitive notion that a moving particle follows a definite path through space. Recently, Yves Couder, a physicist at Université Paris Diderot, has conducted a series of experiments in which millimeter-scale fluid droplets, bouncing up and down on a vibrated fluid bath, are guided by the waves that they themselves produce. In many respects, the droplets behave like quantum particles, and in a recent commentary in the *Proceedings of the National Academy of Sciences*, John Bush, an applied mathematician at MIT who specializes in fluid dynamics, suggests that experiments like Couder's may ultimately shed light on some of the peculiarities of quantum mechanics.

Takeaway: DeBroglie's and Bohm's Pilot Wave theories are a good guide for how radiation and particles are driven in their kinematics and dynamics in our 3-D space. Their predictions match Quantum Mechanics, while maintaining a clear ontological view. This view is consistent with our PL approach.

3.12 - ORIGINAL DE BROGLIE

De Broglie, being on the fringe of the theoretical Physics world of the 1920's, was hampered by the state of French science at that time – with only 3 chairs of physics in all of France, and a boycott of all things German, including the budding theories of QM and statistical mechanics.

But his insight was brilliant none the less. Had he persisted in it (as Bohm eventually did), he could have made a great impact on the emerging QM concepts. His ideas closely approximate our proposal for a PL world – with matter and wave being appearances of one and the same reality. But he was cowed by the Copenhagen mafia, as was Schroedinger somewhat, and backed off of a brilliant idea.

The simple idea: Any massive particle (including photons, to which he assigned a very slight $<10^{-50}$ gm mass) exhibits an associated “internal periodic phenomenn” (un phenomene periodique interne). (Not far from our matter as spinning photons idea). He based this on hints from Hamilton-Jacobi theory, geometrical optics, and the ties of quantum numbers to wave phenomena. The period of this phenomena would be such that it obeys the quantum $h\nu=mc^2$ rule.

For a moving particle, de Broglie associated two periodic motions v and v_1 , one of which **exceeded the speed of light** (with a velocity of c^2/v), a so-called “fictive” wave not carrying energy, but associated with the movement of the body. Both wave motions were always **in phase**. This simple property led to his calculation of the period of revolution of electrons and obtained the quantization effect, replicating Bohr’s quantum condition for an electron moving on a circular orbit. The idea was inspired by Einstein’s “Ghost Field”, and Pauli usually referred to it as the “Einstein- De Broglie Radiation Field”.

M. Brillouin, a colleague of De Broglie, had earlier shown that elastic waves emitted by moving particles create “inherited fields”, i.e. an action reminding the electron of a finite number of its previous positions, and that the periodicity of the motion is characterized by integral numbers.

De Broglie thus differentiated between a “group velocity” (which we see as the normal particle velocity) and the phase velocity of the waves- his “phase wave”, or fictive wave (our Pilot PL wave). In fact, to resolve some issues in calculating light velocities, he attributed a very small mass to the phase wave

that depended on the number of quanta – something that agrees with the Pilots PLs having a small mass, as they are the constituents of mass. (De Broglie admitted that “the real structure of radiant energy remains very mysterious”. Those “isolated bits of energy” have confounded since.)

Now the clincher: “At each point of its trajectory, a free particle follows in uniform motion the “way” of its phase wave, what is (in an isotropic medium), the normal to the surfaces of equal phase.” Light quanta and electrons are particles and waves at the same time, and their motion agrees with the usual dynamics (principle of least action) or geometrical optics (Fermat’s principle). For photons, the probability of absorption is tied to the phase wave vector, explaining interference patterns. The Phase wave is “guiding the propagation of the energy”, which allowed the “synthesis of the waves and the quanta”.

A Phase wave is associated with each particle, being in phase with the particle at any space-point and having its frequency and velocity determined by the energy and velocity of the particle. “The rays of the phase waves coincide with the trajectories dynamically possible”. The guiding rules are the classical Fermat’s principle and Maupertius’ principle of least action. Resonances with the phase wave enforce the quantum rules, such as the quantized Bohr orbits. Mauguin “regarded them as very interesting objects of imagination, which allowed one – for the first time- to avoid the completely empirical character of the quantization rules, providing the latter with a simple, almost familiar, interpretation analogous to the laws of vibrating strings.”

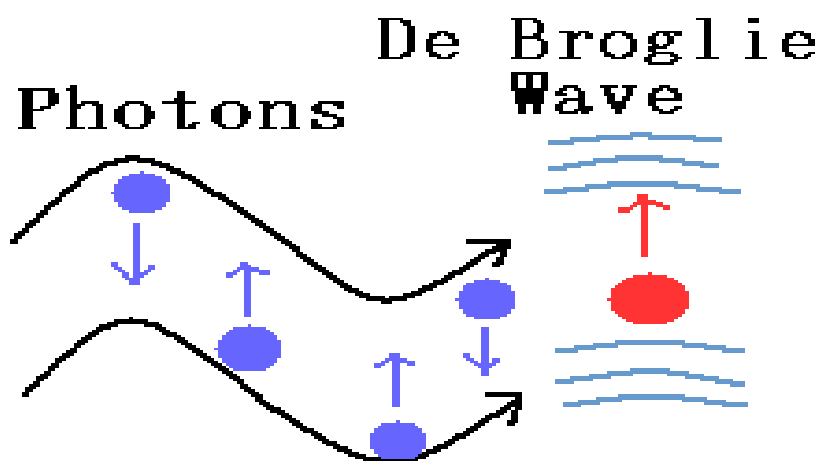
“Fermat’s principle applied to the phase wave is identical to Maupertius’ principle applied to the moving particle; the dynamically possible trajectories of the particle are identical with the possible rays of the wave.” Unification! The quantum conditions of multiply periodic systems followed from the assumption that the electrons in atoms were accompanied by phase waves. When the electron moves in a closed orbit, its phase wave should behave analogously to a wave of a fluid in a closed channel of finite length l . A stationary orbit will exist when we have “resonance” – when the integral multiples of the wavelength of fluid motion, $n \cdot l_w = l$. Applying this to the phase wave, we get Bohr’s quantum condition for the circular orbits in the hydrogen atom. Too much of a coincidence? You bet...

While De Broglie had “intentionally left vague the definitions of the phase wave and the periodic phenomenon, as well as of the light quanta”,

“considered rather as a scheme whose physical content is not fully defined”, our PL proposal fills in this gap, describing the quanta and the particles as oscillating waves on PL Fluid, with emanations in multiple dimensions of a Hilbert space presenting charge and other properties, while still building up to the same overall story De Broglie told.

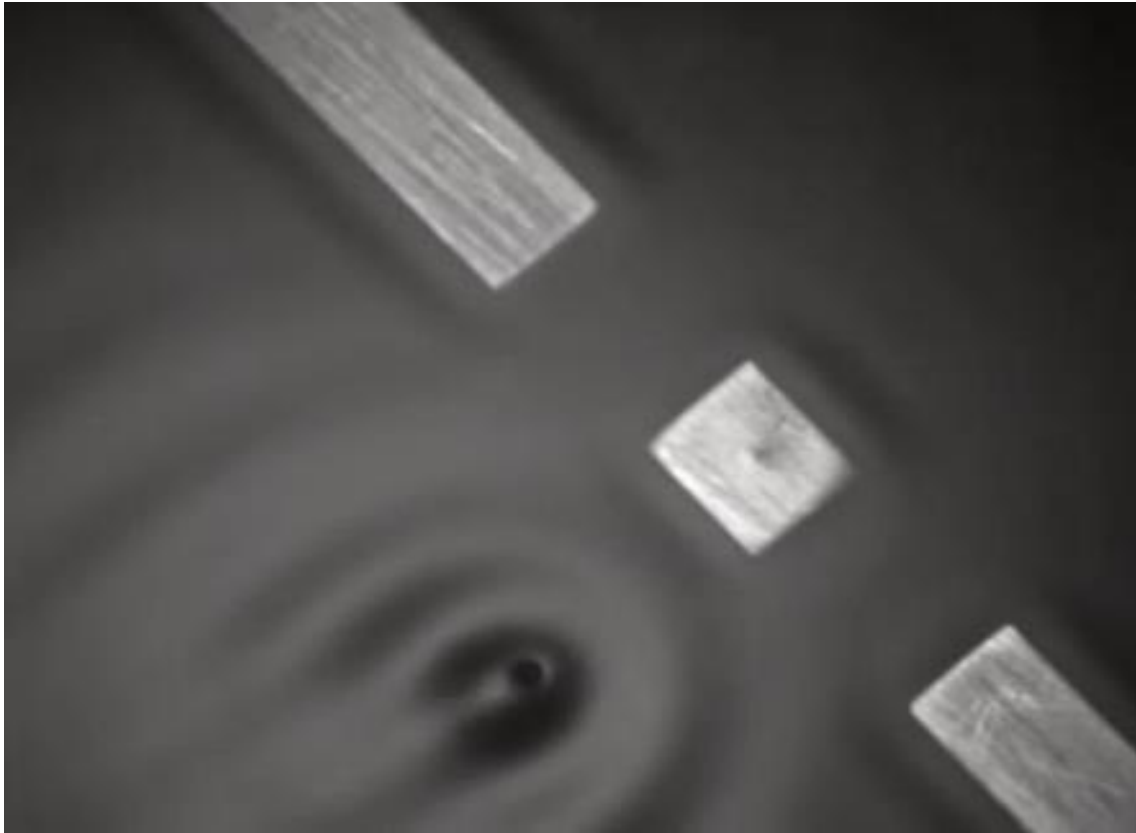
Part of the “periodic phenomena” De Broglie left vague was made clearer by Uhlenbeck and Goudsmit, who saw the fourth degree of freedom in the 4 quantum numbers as referring to “some kind of internal motion”, “an intrinsic rotation of the electron”, aka electron spin, Pauli’s fourth quantum number. Our spinning photon loop! Kronig, who first predicted electron spin (but shot down by Pauli – “Kronig had almost discovered spin/ If Pauli had not frightened him” ☺), calculated the internal velocity as close to the speed of light (or perhaps exceeding) – again our spinning photon at work (with relativistic and space warping effects accounting for speed variations). Compton went further and indicated this calculation implied an electron size of around 10^{-11}cm , in general agreement with scattering experiments.

Interference phenomena result from “agglomeration of quanta”, which are guided by their phase waves, and hence are not independent but coherent. Their behavior is similar to the agglomerations studied in Planck’s and Einstein’s black body radiation at equilibrium, with energy fluctuations, as well as Brownian motions. The phase wave hypothesis supported Einstein-Bose statistics, a further confirmation of its validity.



This theory even inspired Schroedinger to create his wave mechanics. Schroedinger’s elaboration of De Broglie’s ideas became the mainstay of Quantum Mechanics, until Born’s interpretation changed it into something

even Schoedinger did not like. But the fact remains that De Broglie's idea is consistent with QM, and therefore carries along its success. With Bohm's help, it replicates QM, while still providing a "visual" picture of what is happening. De Broglie's Phase wave becomes Bohm's Pilot wave.



Couder's 2010 "walking droplets" experiments, demonstrating the pilot-wave behaviour in a macroscopic mechanical analog. Macroscopic oil droplets on a vibrating surface provide a model of wave-particle duality – the localized droplet creates periodic waves around and interaction with them leads to quantum like phenomena (double slit interference, unpredictable tunneling, orbit quantization (droplet has to “find a resonance” with the field perturbations it creates by syncing its internal phase), and the Zeeman effect. Basically, a macro Pilot wave in action.

In the case of light, the guide wave is the EM wave of Maxwell, where the group velocity matches the wave velocity, and the QM phase has the same significance as the classical phase. The guide wave is measurable. Its amplitude, in this case, is **not** the square root of probability of finding the photon at that point – that is obtained from Feynman's QED, which says clearly light is a particle – Feynman was adamant about this. Interference for

light is not related to “probability waves” – but to the electromagnetic waves themselves. Dirac did not even attempt to write a Photon wave function. The wave function for light is not derivable in QM, but it is real and measurable, classically – the photon annihilation and creation operators in QED correspond to particular modes of the field, which are solutions of the classical Maxwell equations. Pascual Jordan, puzzled by “the vexing problem of Einstein’s Light Quanta”, explained the corpuscular properties of the EM field “by applying quantum mechanics to the Maxwell field itself”. Feynman’s QED and Path Integral formulation does not mention the QM wave function. “The equivalence between Maxwell equations and Schroedinger equations shows that the Maxwell equations actually describe the quantum properties of electromagnetic radiation at first quantization level” (Chandrasekar).

Bialynicki-Birula and Sipe defined a photon wavefunction whose modulus squared gives the photon mean energy density at a given position, obeying the Fermat principle. That wave function is simply “the complexified form of the Maxwell equations used by Riemann, Silberstein and Bateman”. Bialynicki-Birula notes the “great similarity between the wave equation for the electron (or even better for the neutrino) and the Maxwell equations”. He thinks this could have led to a great simplification of the analysis of electromagnetism. In short, the wave of the photon is its own wavefunction, an almost ideal representation of the non-dissipative wavepacket Schroedinger originally envisioned for matter. Mohr describes a six-component form of the Maxwell equations, invariant under Lorentz transformations, where the electromagnetic field may be interpreted as the photon wave function. Bohm considered the photon a “field beable” in its configuration space, the field variations forming a wave packet out of its “super-quantum potential” field. (In QFT, “the operator that adds a location to the detector vector for photons obeys an equation equivalent to Maxwell’s equations” (Marbuger)). When you detect the photon, you detect its wavefunction.

For De Broglie matter waves, it is not directly measurable, but exists in configuration space (of which I propose our 3-D space is part), and is equally real. The amplitude of a light wave implies a density of light quanta, whereas for a matter wave, the amplitude squared represents a “density” (probability) of matter quanta.

Pascual Jordan had understood early that the wave-like behavior of the quanta is a straightforward consequence of imposing Einstein's discreteness to the intensity of a classical field – again a non-local physical entity which exists in ordinary three dimensional space (or 4-dimensional space-time). Instead of explaining phenomena like diffraction and interference as a result of “probability waves”, they are seen as properties of the field of which the particles are the quanta. In his paper “On waves and corpuscles in quantum mechanics”, he shows that the quantum field is equivalent, in all its physical properties and intensity fluctuations, to a corpuscular system. The wave-particle duality is deduced by simply imposing Einstein's quantization to the states of a classical field represented by statistical ensembles in phase space.

The De Broglie wave meets Leibnitz's definition of reality: “The best clue of the reality of phenomena, the one that alone is enough, is the success of the prediction of future phenomena on the ground of past or present phenomena, whether the prediction is based on a reason or hypothesis so far confirmed or it is based on a custom constantly observed.” To say something is both a wave and a particle depending on how you look at it, is to say it is and it isn't, violating the Parmenidian admonition: “You shall never constrain to be that which is not.” What “is and is not” can only be apparent. Venus is both the morning star and the evening star, despite appearances. Bohr would have said “it depends”. It doesn't. Similarly, if something appears as a wave and another time as a particle, we have to dig behind the appearances. As Notarrigo says, “According to these elementary rules of logics, or if you wish of “linguistic conventions”, and logics is nothing but this, it is not possible that something is ***at the same time*** “wave and particle”... (referring only to the sensorial impressions we received when watching the sea waves and a falling stone)”.

Recently, Marcello Cini derived a Wigner representation of QM in phase space without Schroedinger's equation and its probability interpretation. His approach leads to the conclusion that the wave-particle duality has nothing to do with “probability waves”, but is simply the manifestation of two complementary aspects (continuity versus discontinuity) of an intrinsically non-local physical entity (the quantum field) which objectively exists in ordinary three dimensional space! By generalizing classical statistical mechanics in phase space, and introducing uncertainty and discreteness, the results of QM are replicated. Phase space, the original source of the quantum (Planck's discrete action), is the key. The analysis even leads to an exact

equality in defining the Heisenberg uncertainty principle (usually stated as an inequality). Cini sees the elimination of the Schroedinger probability waves from QM as akin to the elimination of the Ether in SR – Occam’s Razor at work again.

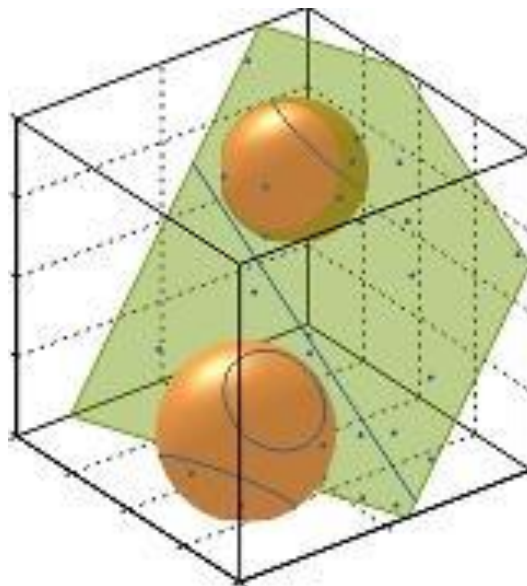
As Introzzi and Rossetti demonstrate, the Guide wave in the De Broglie interpretation can explain double slit experiments which are done “one particle at a time” separated by time. They can explain the interference effects of those disjoint incidents better than the standard QM explanation. Sheldon Goldstein says “there are a variety of experiments and experimental issues that don’t fit comfortably within the standard quantum formalism but are easily handled by Bohmian mechanics. Among these are swell and tunneling times (Leavens, 1996), escape times and escape positions (Daumer et al., 1997a), scattering theory (Durr et al., 2000), and quantum chaos (Cushing, 1994, Durr et al., 1992a)”. As our experimental technology improves, some (e.g. Nistico et al) have been able to circumvent the complementarity restrictions, doing interference experiments where “Which Slit” property is maintained without erasure.

No more Particle or wave. It is Particle and wave – ***two things***, joined together. A single experiment could display both the wave-like and the particle-like behavior of a quantum system simultaneously (Greenberger-Yasin). The Guiding wave, with its particle, (or in case of a “split”, an “empty wave”), is a physical wave, in a multi-dimensional configuration space, providing the origin of the mysterious non-locality, and all of the Quantum results. These Waves are real waves, not wave functions or wave equations. These fields have been interpreted in experimental setting as even interacting with EM fields (since they resemble them, having orthogonal real and imaginary (complex) parts, like the electric and magnetic components of an EM field), producing photons, and also impacting un-associated particles, demonstrating their non-locality in ordinary space. The “quantum velocity term” (dependent on the gradient of the phase of the wave function, and not its amplitude, allowing action over large distances) brings in the non-local aspect, being a function of the intersection of both particle wavefunctions.

De Broglie had presented this particle-wave duality in his double solution, with the wave cloud guiding the statistical probability of the corpuscle motion. He used Madelung’s hydrodynamical interpretation to envision the “structural

picture of a wave with a corpuscular singularity”. Bell emphasized “that in this compound dynamical system the wave is supposed to be just as ‘real’ and ‘objective’ as say the fields of classical Maxwell theory – although its action on the particles is original. *No one can understand this theory until he is willing to think of Ψ as a real objective field rather than just a ‘probability amplitude’.* Even though it propagates not in 3-space but in $3N$ -space.”

A question on phase space comes up: the QM formalism indicates this space has $3 \times N$ dimensions for N particles, which can grow very quickly. However, it has been shown that QM can be formulated in a way that does not involve configuration space, but ordinary space (formalism of field operators, also called second quantization) (Laloe). BEC condensates for dilute gases reflect a condition where the many particle matter waves propagate in ordinary space, resembling sound waves, as Schrodinger would have hoped. This is so because the BEC is a superfluid, like our PL Universe, as we have seen. Going one step further, I propose that each particle lives in its own 3-D mesh sub-space, which when combined with another particles, provides the $2 \times 3D$ space of the “configuration space”. When the particles are aligned (e.g. BEC), or entangled, these 3D spaces align, and at macroscopic levels produce our 3D world (or at least a large coherent patch of subspace). Hence the $3 \times N$ dimensions of configuration space are N 3D sub-spaces of our 3D space.



The recent approach of Quantum Bayesianism (QBism) (Caves, Fuchs & Schlack), where the wave function is seen as a “private” probability view of the specific observer that gets updated on observation, rhymes with our

description above, since each observer will meet this particle subspace differently. One proponent (Mermin) says: The quantum system examined by an observer is indeed very real, and QBism suggests a split or boundary between the world in which the observer lives and that person's experience of that world, the latter described by a wave function. "With every measurement set by an experimenter's free will, the world is shaped just a little as it participates in a kind of moment of birth" (Fuchs). Daneri, Loinger and Prosperi had similar ideas, where the collapse of the wavepacket represented an increase in information and an irreversible process in the act of observation, with QM simply describing the interaction of that micro-system with the macro-world.

"The phase can be seen in many ways to be what we call the 'vacuum', while the amplitude corresponds to the particle. In a sense, the phase is the connection of the particle to the rest of the Universe, the carrier of non-locality, ... It is like a signal sent out by a fermion asking other fermions, etc., to organize themselves with respect to it, and to aggregate" (Rowlands). It is De Broglie's "Double Solution", a knot or Eddy in a wavefield being guided by it. The Standard Model reflects this duality in the split between Fermions (discrete particles) and Bosons (continuous fields, waves), that are matched together by Symmetry rules.

Einstein's General Relativity (GR) had already determined the gravitational field energy is partially or wholly non-local. "Is there a connection between the non-locality of energy in general relativity, and quantum non-locality?" (Peacock). Bohm's guiding wave does possess part of the total energy of the particle it describes, as does our PL Pilots wave, and perhaps that is the carrier of non-locality. "This energy will be a property of the entangled states as a whole and will not be localized to the particles, just like Bohm's quantum potential for entangled states. (In fact, entanglement energy and the quantum potential might be the same thing.)" (Peacock). This energy could also explain Landauer's minimum energy associated with a bit of information. Bothe had proposed a "fuhrungsfeld" (guiding, pilot field) which contains only a vanishing fraction of the total energy emitted, as a possible way to explain the riddle of radiation, with the function of the wave field consisting of "steering the light-quanta in such a way that on the average the classical energy distribution results".

One hint at the reality of wavefunctions can be seen in the “Quantum Revival” experiments where a “quantum wave packet – representing an electron in an atom, for example – can be constructed from a superposition of highly excited stationary states so that it is localized near a point on the electron’s classical orbit” (Berry, Marzoli & Schleich), and starts to propagate again around the orbit once the packet is released, an effect similar to Henry Fox Talbot’s carpets of light.

Bohm’s & De Broglie’s proposals are not “Hidden Variable” proposals, since the variables are the positions, the only real measurable, not really hidden. “It would be appropriate to refer to the x s as ‘exposed variables’ and to Ψ as a ‘hidden variable’. It is ironic that the traditional terminology is the reverse of this” (Bell). Their waves are the streams carrying the “chips of wood” (particles). They are “causal” interpretations that return us to a visualisable ontology of the world. They provide an “anschauliche” (intuitive) picture of reality, as Schrodinger, inspired by Einstein, had hoped, by “proving this undulatory field – whose physical nature is so far still in the dark – by the phenomena of motion corresponding to it”. Bohr, of course, to whom the complementary quality to truth is “clarity”, didn’t like this. But Einstein, he of the “Führungsfeld (guiding field)” idea, and who had in 1927 created a similar, unpublished theory (mainly due to its non-locality), knew that quantum physicists would one day reach “the limits of their mania for the statistical fad, and return full of repentance to the spacetime picture”. He himself thought that De Broglie had “lifted a corner of the great veil”.

The De-Broglie- Bohm approach provides an ontology for QM and our reality. Our PL proposal provides an ontology for the Pilot wave underlying it.

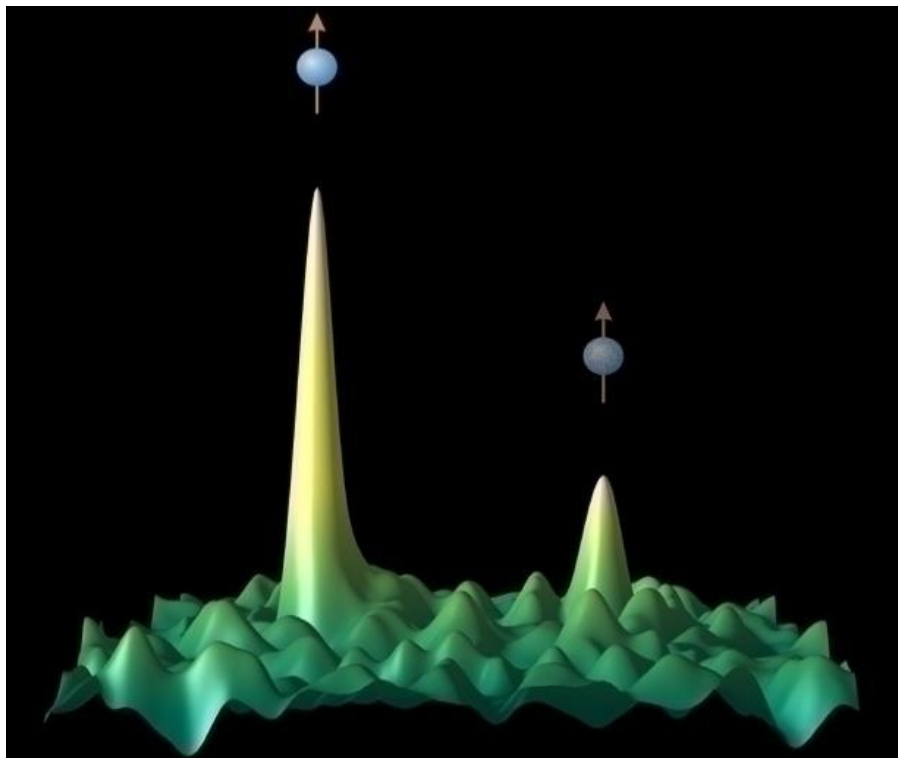
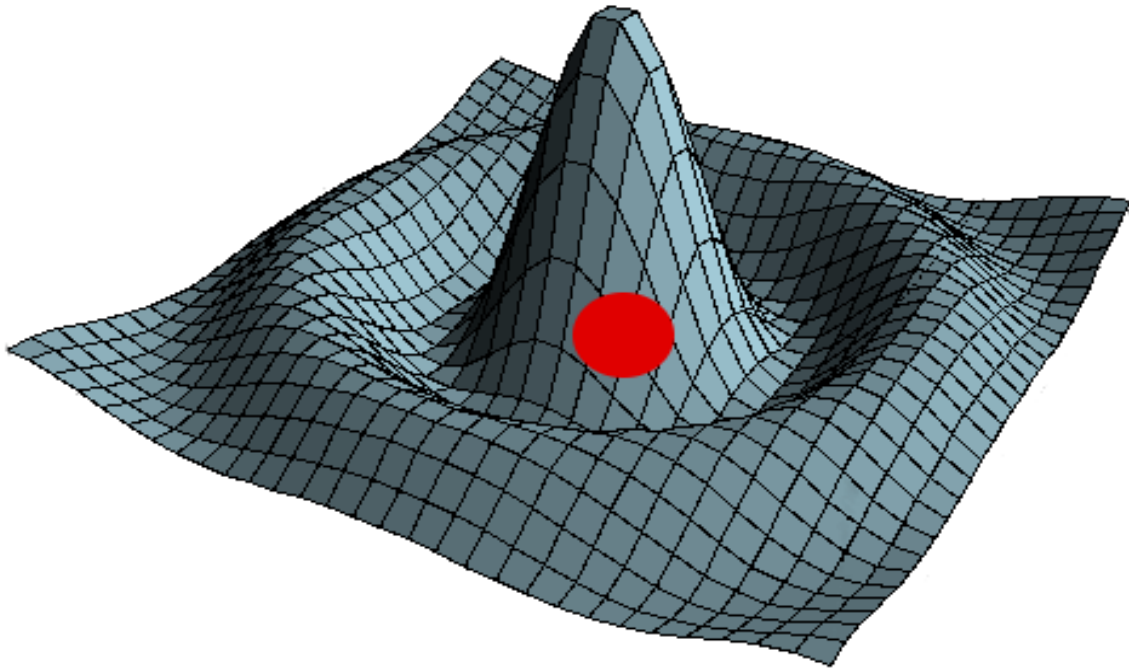
“I feel that the last word has not been said yet about the relationship between waves and particles.” – Dirac

“One should keep a completely open mind for the future... One should not build up one’s whole philosophy as though this present quantum mechanics were the last word. If one does that, one is on very uncertain ground and one will at some future time have to change one’s standpoint entirely.” – Dirac

***“Of the founding fathers, only Einstein thought that de Broglie was on the Right lines.”
– John Bell. (Only Einstein!! ☺)***

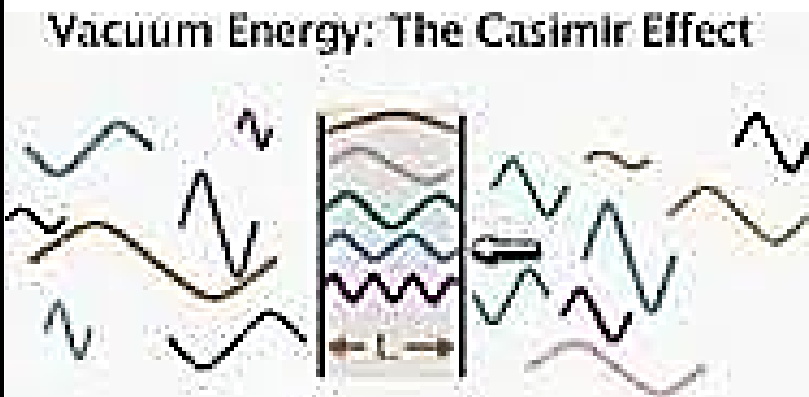
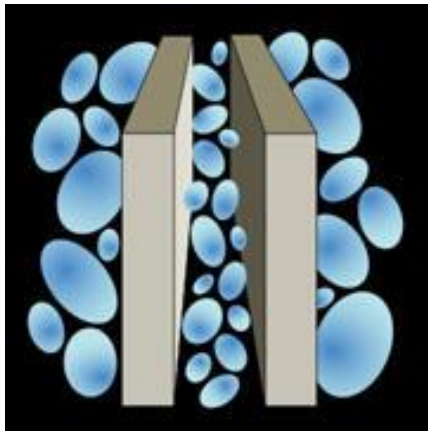
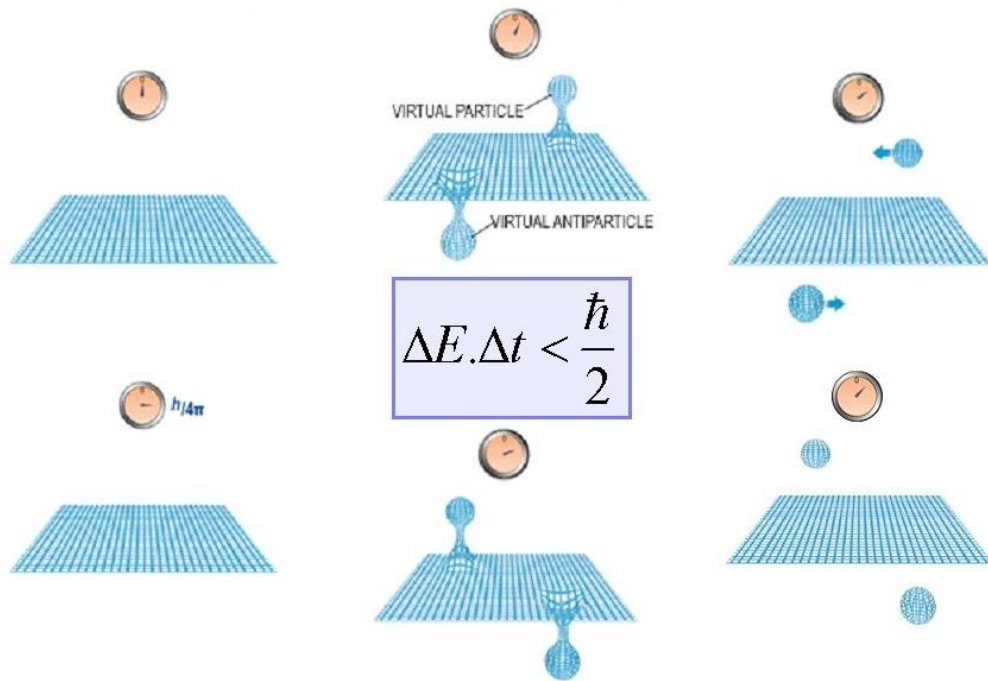
“In my opinion the pilot wave picture undoubtedly shows the best craftsmanship among the pictures we have considered.” – John Bell

“To restrict quantum mechanics to be exclusively about piddling laboratory operations is to betray the great enterprise. A serious formulation will not exclude the big world outside of the laboratory.” – John Bell



Takeaway: The Pilot waves, Einstein’s “Gespensterfeld”, are the highway map of our reality on which the particles and photons ride.

Virtual Particles...



The same process that generated the initial singularity is played continuously at a smaller scale throughout the void. The continuous creation of PLs from the logic of existence, normally creating additional space nodes and expanding

space, will routinely create “clumps” of Pls in the EM dimension by the same rules of logic that led to the initial accumulation in the Big Bang. The presence of particles in the vacuum further accentuates and amplifies this process.

As that density grows, it turns from “Vacuum Energy” (very light Pl density, say one PL per 3-D space node), to “Dark Matter” and WIMPs (thousands of Pls per 3-D node, perhaps the lightest SUSY partners), until it gets to a sufficient size where it can initiate the EM cycle, starting a rotating circular motion that we interpret as the ephemeral particles – “virtual particles” emanating from the vacuum. The process can be seen as a sort of “Brownian motion” effect a-la- Smoluchowski & Einstein, who had demonstrated that random density fluctuations become much higher for smaller volumes, resulting in density peaks – leading to particle formation. Prigogine’s “dissipative structures” show a similar tendency – having a “non-vanishing probability of reaching the unstable region through fluctuations”, with non-linear dynamics then taking over, where “certain types of fluctuations will be amplified” and “give rise to a macroscopic current beyond the instability” (I. Prigogine). Given their formation pattern, those particles will generally come out in particle-anti-particle formations, as a natural result of the symmetry of the space and conservation laws (momentum, both linear and angular). Those particles will quickly interact again, and annihilate, diffusing their constituent PLs back into the background space.

The formation of those particles and their configurations will be greatly affected by the structure of the space around them, leading to oscillations and variations of their density, leading ultimately to effects like the Casimir effect and similar phenomena. In fact, those virtual particles manifest themselves only when something disturbs their quantum vacuum.

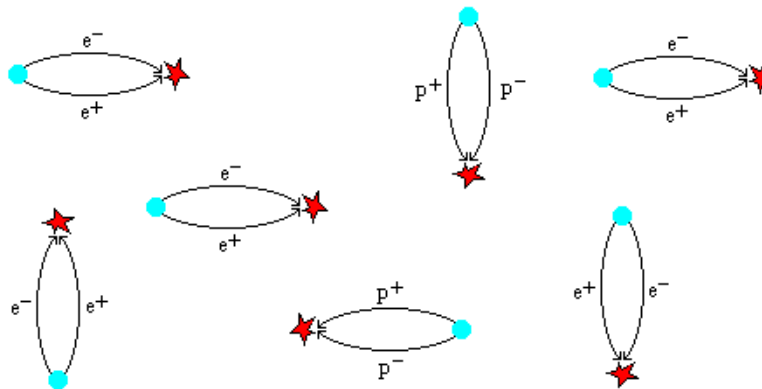
This continuous generation of particles will enhance the space formation and expansion, and will also occasionally lead to permanent photon generation, and particle generation, continuously enhancing creation and “mass” of the Universe, albeit at a slow cosmological rate. This can play into some of the “condensation” theories and “cosmic rain” scenarios. Continuous fluctuations and aggregations of PL clusters would resemble the proven fluctuations of gas particles density demonstrated by Einstein and others.

Those particles could be Wilczek’s “cosmions”, or Wimps, or very light Axions ($<10^{-6}$ eV), that can metamorphose into the heavier particles. Some theories

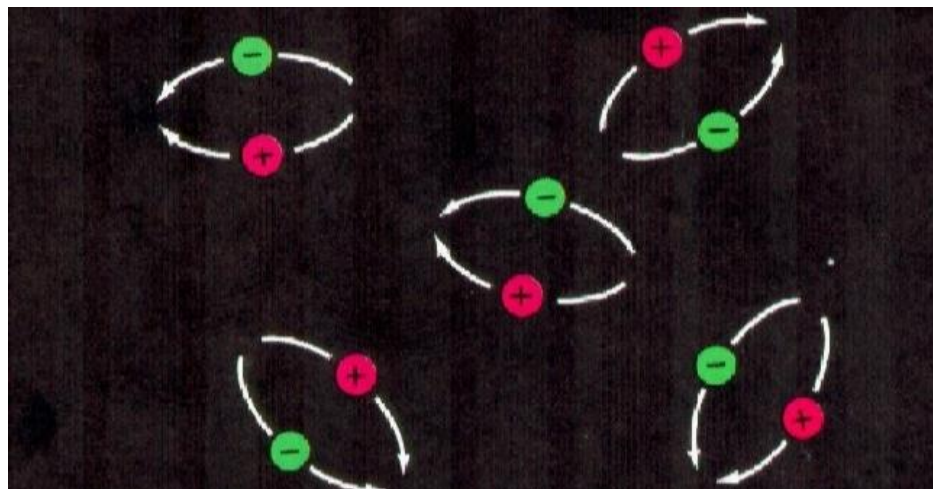
predict large surges of these particles could explain formation of extra-high powered Gamma Rays in outer space, as well as explain Neutrino origins. The statistical “creation” algorithm for those PL “burps” is to be determined, and its variability may determine the types of particles it can create. It is certainly clear that it obeys different rules than QM, whose predictions for the energy of those particles is off by a factor of 10^{120} !

Quantum Vacuum

the quantum vacuum cannot be perceived or measured directly since it appears to be empty, in fact it is filled with potentiality

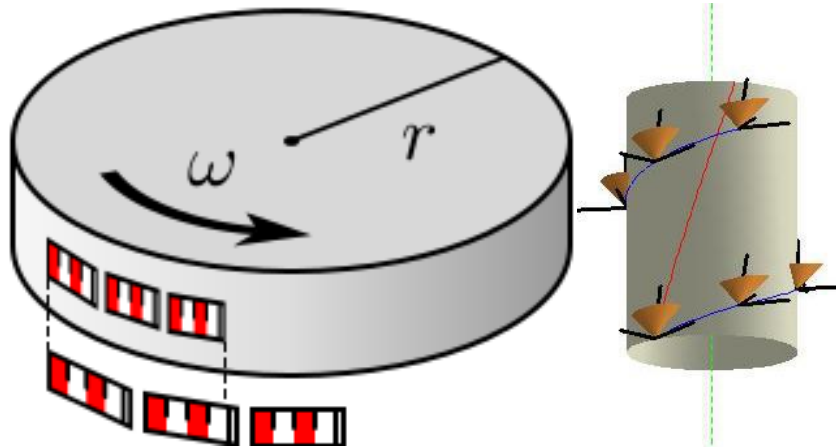


within the quantum vacuum, pairs of virtual matter and anti-matter particles are continually created and destroyed, borrowing their mass/energy by the uncertainty principle. They do not exist as observable entities, but their existence is exerted on other particles as a subtle pressure (called the Casimir effect)



Takeaway: Virtual Particles are short lived resonant excitations of the vacuum, amplified by the particles themselves when present.

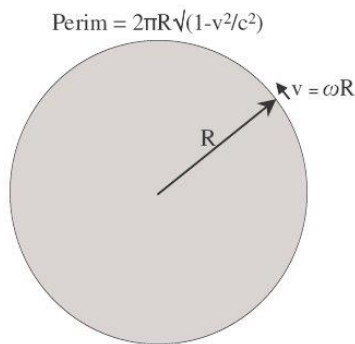
3.14 - EHRENFEST PARTICLES?



If we think of matter as photon/energy resonances, spinning around a hypothetical center, then we must face a number of paradoxes:

- As Ehrenfest pointed out, the center (or “stationary”) observer will see the circumference shrunk, as it moves near the speed of light.

$$\frac{\text{circumference}}{\text{diameter}} = \frac{2\pi R \sqrt{1 - (\omega R)^2/c^2}}{2R} = \pi \sqrt{1 - (\omega R)^2/c^2}, \text{ which goes to zero as } v \text{ goes approaches } c.$$

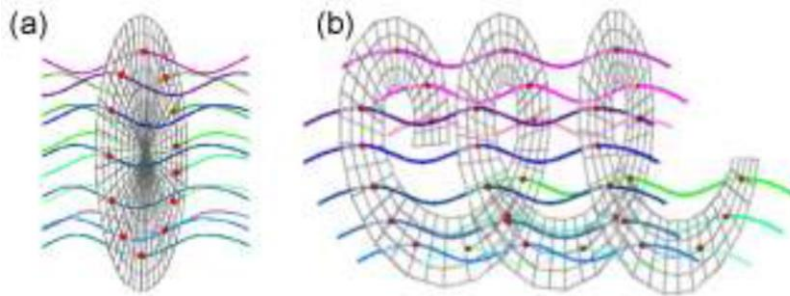


- An observer on the rotating circumference will see a circumference of:

$$C' = \frac{2\pi R}{\sqrt{1 - v^2/c^2}}, \text{ which goes to infinity as } v \text{ approaches } c.$$

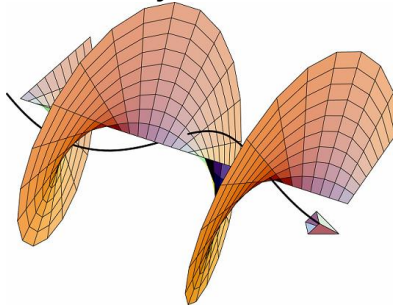
- We also said that light travels in straight lines, so essentially a loop, if it was actually so, would violate this principle unless the “loop” was warped to look like a geodesic.
- So Light must be moving in straight lines and in a loop at the same time?

- Well, here is what this picture looks like:
 - The particle looks to an outside observer as if it was a point particle with Zero Circumference.
 - For Light itself, riding the circumference, it looks like a circle of infinite radius, so as it moves around it, it is approximating a straight line for practical purposes.
 - So for practical purposes, the particle is in one place (the “point”), and at the same time everywhere (the circumference)!
 - Since light is still moving with its characteristic wavelength corresponding to the energy/mass of the “particle” it created, our interactions with it are somehow related to that wavelength where its impact shows.
 - That is why an electron can have point-like interactions, while still having a finite extent.
 - We need to link the math with the mystery. The Duality of String Theory where R and $1/R$ map could be a clue or a tool.
- The same concept also would apply to a “Free” photon, since it also oscillates in the EM dimension in a rotational mode, so the photon “dimension” can look like a point particle and a wave that is everywhere.

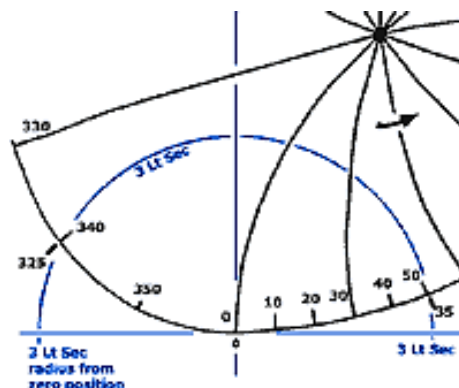


- This definitely means the geometry around the “particle” is non-Euclidean, and needs further investigation. This is already implicit in Ehrenfest’s paradox, showing Relativity and the concept of Rigid bodies as incompatible, and that for a co-rotating observer, geometry is non-Euclidean. It could be the particle is a vortex with its own defined “spacetime” overlayed on the background space-time of the Universe. Such an approach (also proposed by Space-Time Helix concepts) could explain many aspects of uncertainty, entanglement, measurement, and probability. Such an analysis needs to take into account:
 - Time Dilation

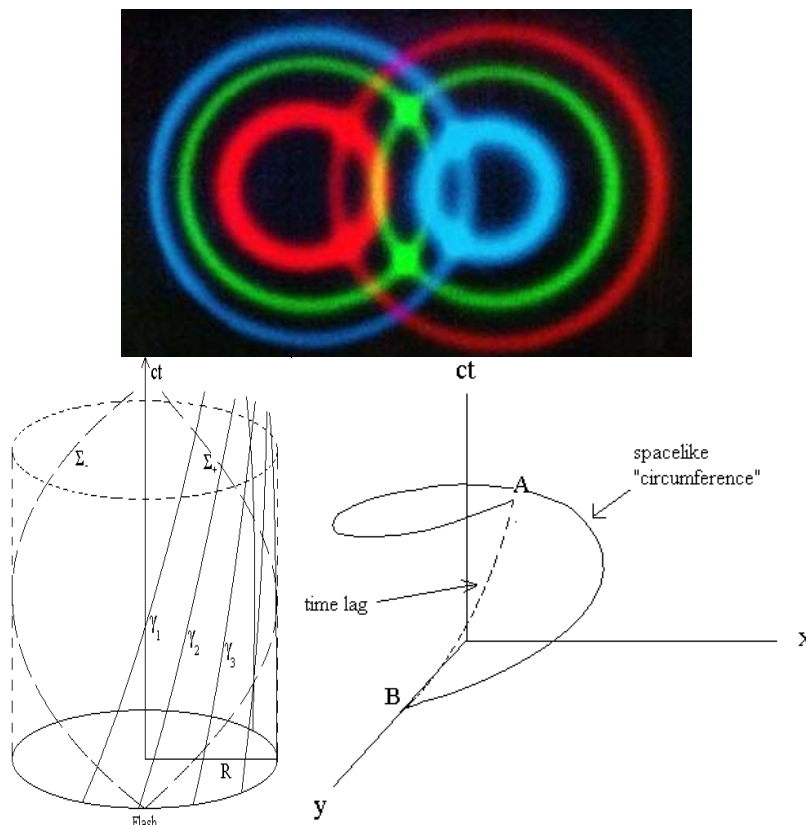
- Mass increase
- Lorentz-Fitzgerald contraction
- Relativity of Simultaneity



- Thad Roberts, in his Quantum Space Theory approach, derives the fine structure constant as an effect of the curvature of space at small scales on the value of pi. If the electron and the proton, etc, are small singularities that warp the space around them this would result in the new geometry, with alpha, the fine structure constant, now relating the wavelength of our PLC to the circumference of their orbits.
- Somehow the particle will live in that specific space-time of its own in its vortex, but still interact with the background spacetime via its characteristic wavelength, giving it the point particle/ wave duality it presents and possesses from its vortex. It will boil down to how this rotating “system” relates to the environment it is in... back to Bohr’s observables, and away from Einstein’s reality.
- So the Particle is truly a “Singularity” in the field, as Field Theory would have it. From the point of view of an “observer”, it is a point particle; From the point of view of its constituent “light”, it is an infinite scape. This means a new geometry is in place, a warped space that makes it look like a straight line to the photon, but a tight point to the observer. A Singularity from one point of view, and a wave from another! They are at one point and everywhere at the same time. Heard this before?



- Somehow the two coordinate systems have to overlap. Measurements at large scales will see aggregate behaviour of particle or multi-particle impacts approximating classical behaviour. But when we get close to the wavelength, the alignment and interaction of the two coordinate systems will become important.
- It could very well be that this alignment of coordinates that presents itself in the “dimensional” aspect as additional dimensions, that simply helps us to “visualize” the action.
- It then could be that two entangled particles, such as two photons shooting away from each other, are really one entity, with two vortices, and when you measure, say, the spin of one “whirl”, you pin down that configuration and its associated vortex, which then dissociates from the other vortex and “whirl”, preserving their correlation in the measurement. The randomness of their “spin” when first measured reflects the “isolation” of their space-time during travel from the framework of the measuring apparatus (our background frame), and the spin, location, etc all get re-aligned when the measurement occurs.

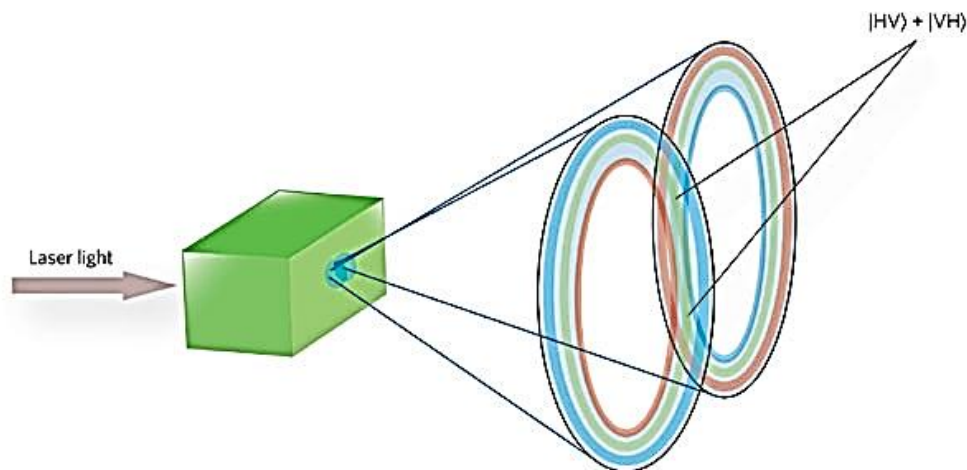


So is this complex enough for you? If it is not clear, then we have achieved one objective: we have demonstrated that our usual, basic, common sense laws

lead to some very funky results that can lead to many “alternative” scenarios, whose resolution involves Nature’s game of infinities, dimensions and realities, including non-locality and entanglement. Since they could easily derive from common sense arguments, then they are not non-sensical as we first thought. We just have to fill in the math in between... that math that Nature has invented and trialled and errored for billions of years.



“If you haven’t found something strange during the day, it hasn’t been much of a day”
- John Wheeler

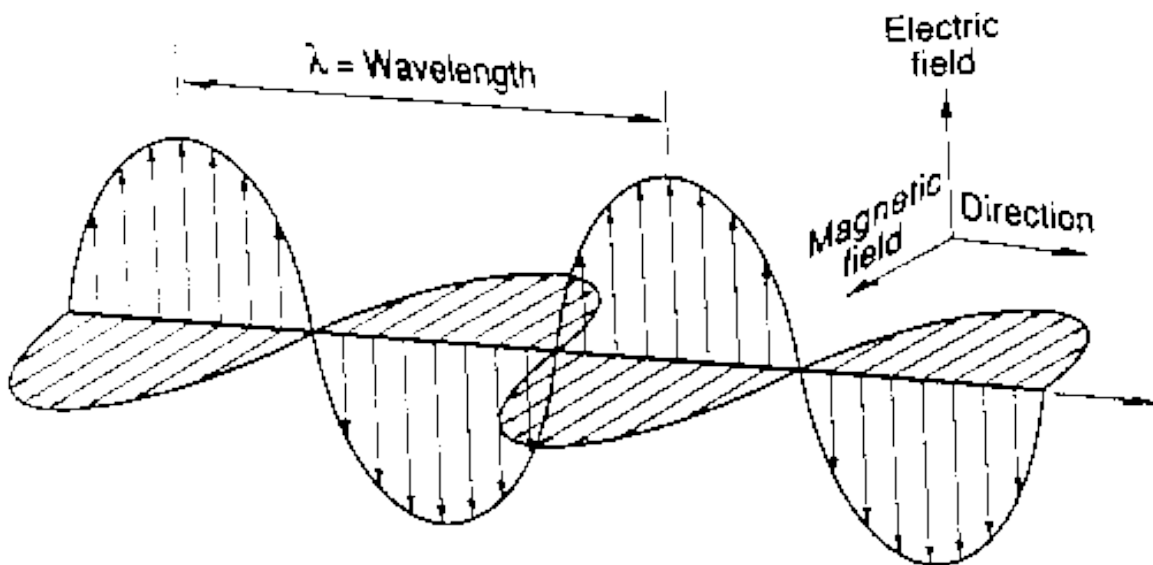


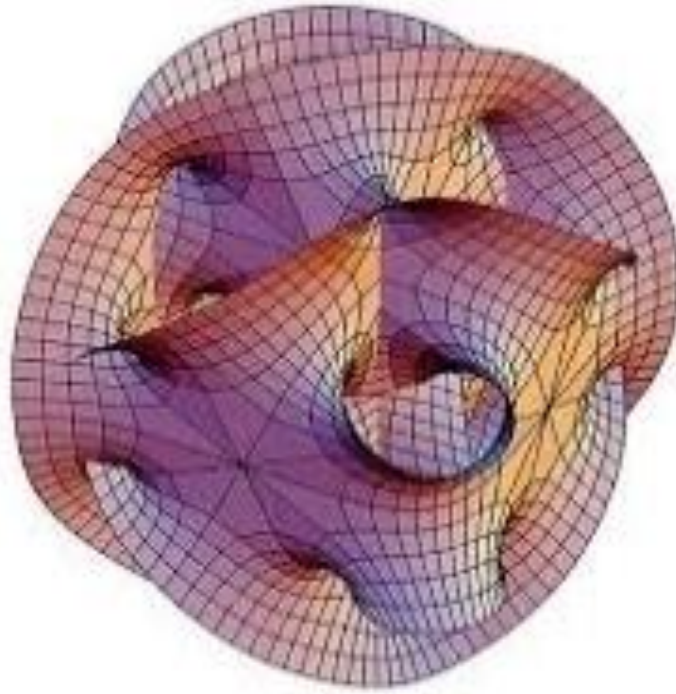
Takeaway: The geometry of space bends with the presence of particle/photon singularities, and the effects of relativity compound that effect. Careful assessment is needed to determine even the simplest rotating configuration and the ontological view of such configurations.

3.15 - CHARGE!

Charge, that simple, unique property that only comes in distinct single units, $+/-1e$, is the result of the configuration of the Matter PLC cluster. It seems there are two such formations, one being the anti-thesis of the other. When joined, they have the power to “unlock” the structure of both, one being the key to the other. Think of it as two spinning configurations, two opposing whirlpools, when joined annihilate each other, turning the waters calm and releasing the water to normal diffusion- in this case the PLs being freed when particle-anti-particles annihilate, forming “free” PLC clusters- Photons, radiation.

So what is it we measure as charge? Quite simply, Charge is the flip side of mass – another dimension in the PL Hilbert space. Aside from our perceptual 3 dimensions of space, mass is an extra dimension, as is Charge, that the PLs protrude into. Actually, both are a mapping of the electromagnetic electrical/magnetic dimension, since mass in our proposal is emanent from electromagnetic light constructions, and Charge is also emanent from the structure of those same configurations. The different strength of those two appearances (mass, charge) and their related forces comes about because of the way they generate from the structure of the resonances that create matter and charge- mass defining the kinematic-dynamic movement impact, while charge reflects the electrical component balance impact.





Calabi-Yau Spaces (from String Theory)

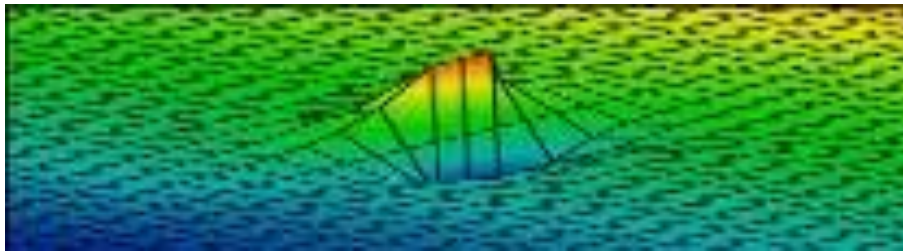
Hint? The same equations govern both their behaviours, with inverse square law attraction/repulsion, fields, etc. Kaluza-Klein's 5 dimensional space time brought Electrodynamics in line with gravity. Dennis Sciama proposed to derive Gravitational laws through an analogy with electrodynamics, using "gravelectric fields" and "gravo-magnetic" fields – and the reverse could equally be done, using "gravitational" charges. Sciama tried to explain Mach's Principle in terms of a gravitational analogue of the acceleration-dependent inductive force of EM theory. Such analogies were used as far back as 1870 by Holzmüller, Tisserand and Levy who applied electro-dynamical equations to solve gravitational problems like the precession of the peri-helion of Mercury. Similarly, the ideas of Supersymmetry require "extra abstracted Quantum-Mechanical dimensions" that help explain charge.

Problem: Why is charge quantized in single units of "e", the charge of the electron, while mass is all over the place?

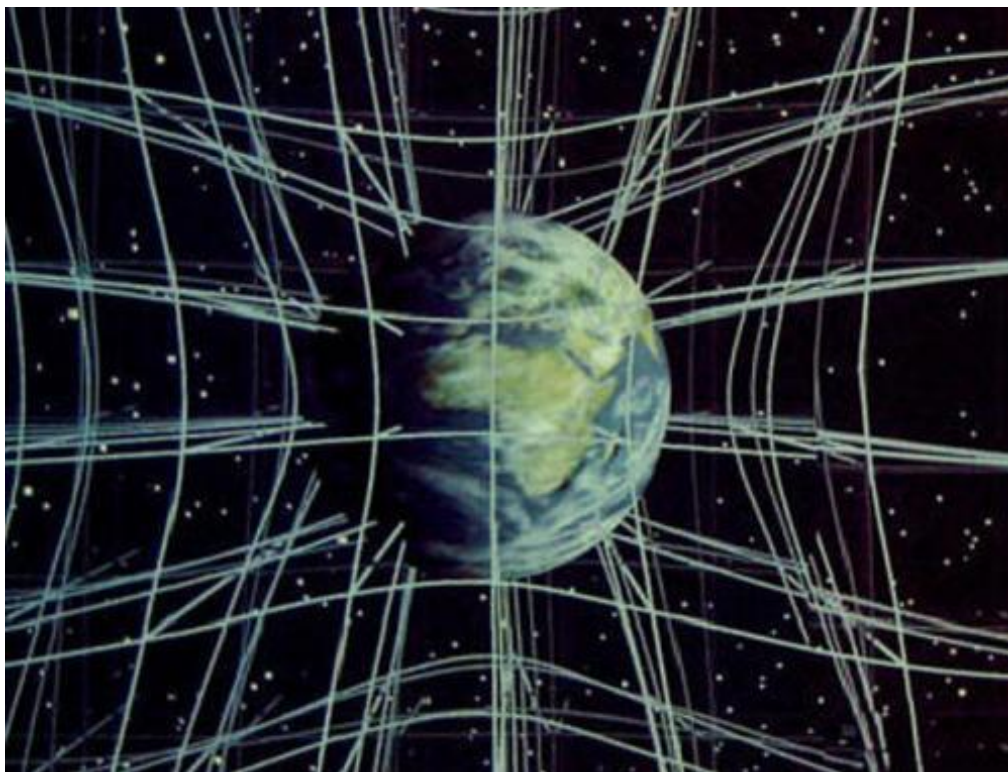
No problem: The key is in the "fixed nugget" of PLs that constitutes the basic quanta of electromagnetic energy – the energy in one "packet" of any magnetic wave – Max Planck's "Drops of Energy".

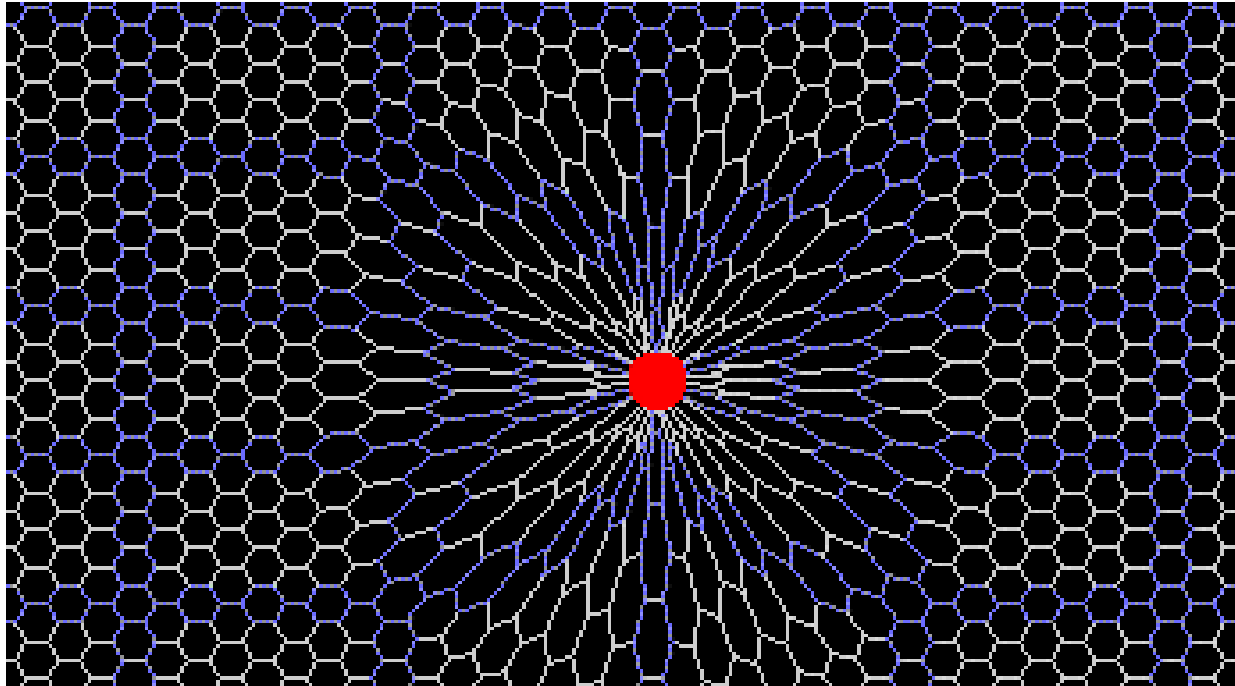
Here is how it goes:

- If our “particles” are trapped resonances of “light”, as we proposed, then these “particles” are made up of those PL nuggets that constitute “light”. The total number of PLs represents the “Mass” of matter.
- The PL nuggets, and light in general, has several appearances to us:
 - o “mass/energy”, being a fourth dimension (alternatively – warp) to the 3-dimensional “space”, representing the number of PLs at a particular “point” in the space, resulting in “gravitational” effects. Look at a “warped” two dimensional space picture:

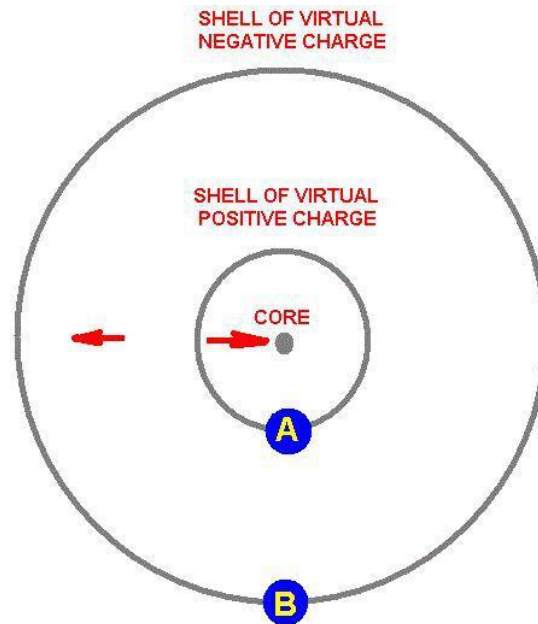


And you are basically seeing its protrusion into an additional space dimension. “Warp” (distortion) and additional Dimension are equivalent formulations of the same concept. The “Warp” produces the effects predicted by General relativity, simulating gravity.

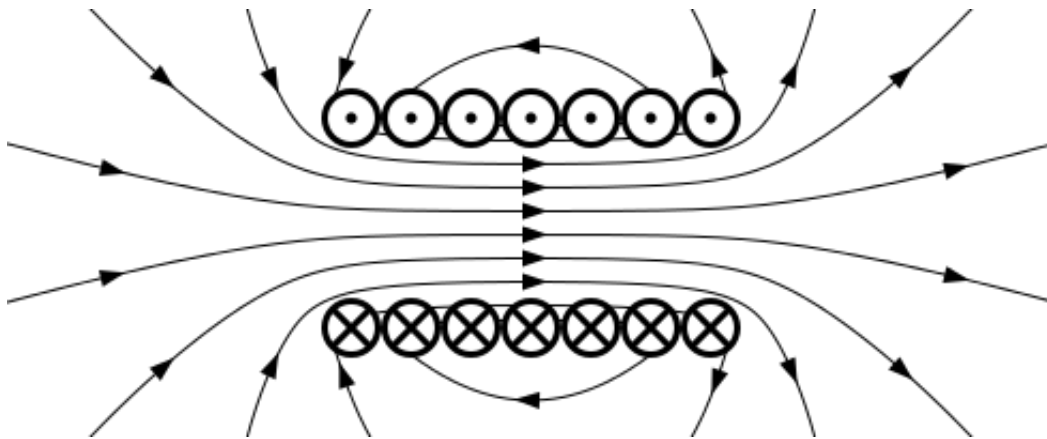




- “Electrical” and “Magnetic” fields, proportional to the “mass” component, orthogonal to each other, essentially also the same extra dimension we feel as “electricity” and “magnetism”
- Both of the above “show” themselves to us when the PLs are traveling in light formation – when their density is such that they reach the “saturation limit” (fundamentally an algorithmic limit in the logical PL Hilbert space- to be defined), and start undulating as a result of the PL Fluid pressure as they travel at the “speed” of light. Below that limit, they are dark energy/matter, undetectable as mass (except for their gravitational effects), and undetectable as electrical/magnetic fields.
- So when light gets trapped in a resonance, and slows the overall forward motion, appearing then as “matter”, the resonance could only result from a fixed set of “nuggets” in circulation, and depending on the configuration of the resonance, a net “electric” appearance would present itself (as opposed to the average undulation of free light which has a zero average charge). A Circulating photon, for example, would present part of its electrical field on the outside, while the oscillations on the “inside” get shielded, presenting a net charge (Dirac had noted “the change in phase of the wave function round any closed curve must be the same for all wave functions”). That would be the “Charge” we see, in a quantized way the same way the Photon PLC nuggets are quantized.

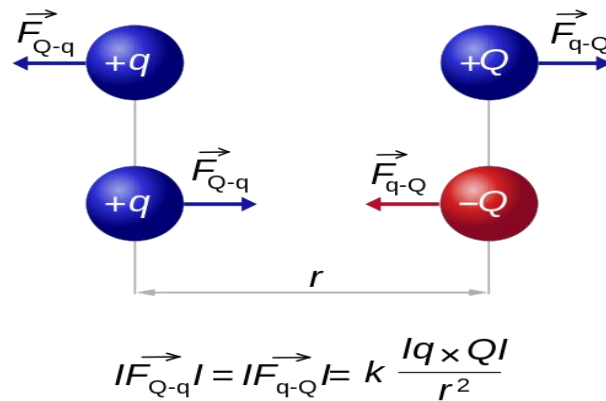


- Since those “Charges” are warps in the space, their effect is similar to that of gravity... their interactions, and laws (Coulomb’s Law), are similar



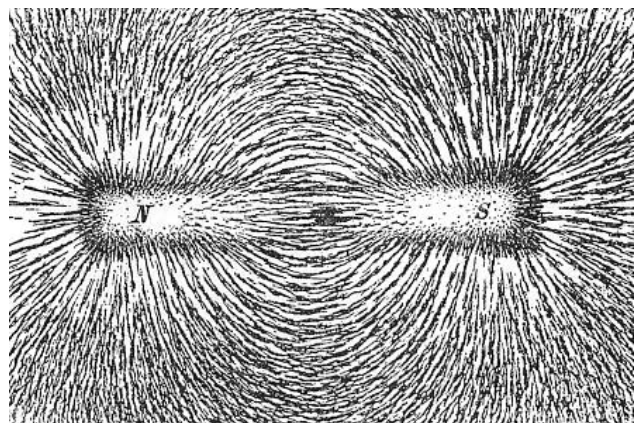
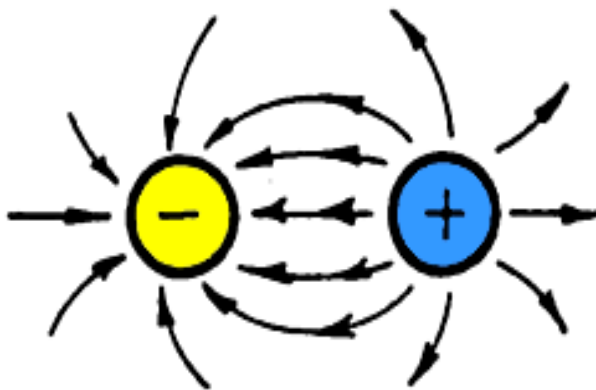
- So Mass & Charge are epiphenomena of the EM dimensional energy, being different projections/manifestations of its structure in the 3-D dimensions. Unlike Mass however, the Charge dimension seems to show a positive and negative stretch – whereas mass is always “seen” as positive (more on this later – negative mass & energy are ubiquitous in anti-mater and other formations). Hence a “negative” charge warps the space in the opposite direction to “positive” charge, and hence the repel-attract behavior of charges. Since this attraction/repulsion is modulated

by the “Pilot waves”, the “messages” sent by the Pilot waves are interpreted correspondingly depending on the direction/sign of charge.



- The postulated 1/3, 2/3 charges of Quarks represent a combination effect, since they come in threes normally for Baryons, and in neutral twos for muons, the fractional charge an emergent “sum” of their three way interaction, a-la-Hall effect (as suggested by Laughlin in his Nobel Lecture).
- The fact that trapped photons in a resonance cavity exhibit electric charge has already been demonstrated experimentally.

So why does an AC current in a wire produce electromagnetic waves (your antenna as an example)? Because the current is those electrons – conglomerate of charged PL nuggets flowing through, the AC part making sure they oscillate with an average of zero. The current then looks like “light” in another form – a “macro-light” if you wish, repeating the undulating form of PL nuggets, albeit slower and more dense, with the resulting electromagnetic fields generated. Think of the current in a wire as a thick, slow photon. Nature again repeating its successes at all levels.



Photons are Charge Free, because they are just that- Free. Their PLC, while dense, is without the restrictive locked form of the “particle”. Its average “electric charge” is zero, as it oscillates in its free travel.

A strong clue to the nature of charge comes from the Fine-Structure Constant, $\alpha = \frac{e^2}{\hbar c}$, a simple but not well understood (written by “The Hand of God” says Feynman, and “we don’t know how he pushed the pencil.”) magic number – “Pauli’s link to the ‘magic-symbolic’ world” (and, disturbingly, his hospital room number 137 in his last days)(Enz). This non-dimensional number gives many hints that the nature of Charge (and its atomicity – Pauli) is related to Geometry- many thinking this correlation the central mystery to be resolved in Natural Philosophy:

- It is possibly a simple geometric function of Pi (Gilson).
- Minor variability of the “constant” over eons, still controversial, seems to correlate with dark matter/dark energy dominated phases, again related to spatial structure.
- It relates the speed of the electron in Bohr’s model to the speed of light, a possible link to the electron’s trapped photons configuration.
- It relates the electron radius, Bohr radius, and Electron Compton Wavelength.
- In QED, it relates the coupling between Electrons (charged) and Photons (uncharged).
- It **relates electrostatic repulsive forces and Gravitational attractive forces between particles of Planck Mass and Elementary Charge, at any distance**- Gravity also being a geometric warp feature.
- From Wikipedia: The fine-structure constant, α , has several physical interpretations. α is:
 - The square of the ratio of the [elementary charge](#) to the [Planck charge](#)

$$\alpha = \left(\frac{e}{q_P} \right)^2.$$

- The ratio of two energies: (i) the energy needed to overcome the [electrostatic repulsion](#) between two electrons a distance of d apart, and (ii) the energy of a single [photon](#) of wavelength $\lambda = 2\pi d$ (or of angular wavelength d ; see [Planck relation](#)):

$$\alpha = \frac{e^2}{4\pi\epsilon_0 d} \bigg/ \frac{hc}{\lambda} = \frac{e^2}{4\pi\epsilon_0 d} \times \frac{2\pi d}{hc} = \frac{e^2}{4\pi\epsilon_0 d} \times \frac{d}{\hbar c} = \frac{e^2}{4\pi\epsilon_0 \hbar c}.$$

- The ratio of the velocity of the electron in the first circular orbit of the [Bohr model of the atom](#) to the [speed of light](#) in vacuum.^[6] This is Sommerfeld's original physical interpretation. Then the square of α is the ratio between the [Hartree energy](#) (27.2 eV = twice the [Rydberg energy](#) = approximately twice its ionization energy) and the [electron rest mass](#) (511 keV).
- The two ratios of three characteristic lengths: the [classical electron radius](#) r_e , the [Compton wavelength](#) of the electron λ_e , and the [Bohr radius](#) a_0 :

$$r_e = \frac{\alpha \lambda_e}{2\pi} = \alpha^2 a_0$$

- In [quantum electrodynamics](#), α is the [coupling constant](#) determining the strength of the interaction between [electrons](#) and [photons](#). The theory does not predict its value. Therefore α must be determined experimentally. In fact, α is one of the about 20 empirical [parameters in the Standard Model](#) of [particle physics](#), whose value is not determined within the Standard Model.
- In the [electroweak theory](#) unifying the [weak interaction](#) with [electromagnetism](#), α is absorbed into two other [coupling constants](#) associated with the electroweak [gauge fields](#). In this theory, the [electromagnetic interaction](#) is treated as a mixture of interactions associated with the electroweak fields. The strength of the [electromagnetic interaction](#) varies with the strength of the [energy](#) field.
- Given two hypothetical point particles each of [Planck mass](#) and elementary charge, separated by any distance, α is the ratio of their electrostatic repulsive force to their gravitational attractive force.
- In the fields of [electrical engineering](#) and [solid-state physics](#), the fine-structure constant is one fourth the product of the characteristic [impedance of free space](#), $Z_0 = \mu_0 c$, and the [conductance quantum](#), $G_0 = 2e^2/h$:

$$\alpha = \frac{1}{4} Z_0 G_0.$$

$$\alpha = \frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar c} = \frac{\mu_0}{4\pi} \frac{e^2 c}{\hbar} = \frac{k_e e^2}{\hbar c} = \frac{c\mu_0}{2R_K} = \frac{m_e c r_e}{\hbar}$$

where:

- m_e is the [electron rest mass](#);
- r_e is the [classical electron radius](#);
- e is the [elementary charge](#);
- $\hbar = h/2\pi$ is the reduced [Planck constant](#);
- c is the [speed of light in vacuum](#);
- ϵ_0 is the [electric constant](#) or permittivity of free space;
- μ_0 is the [magnetic constant](#) or permeability of free space;
- k_e is the [Coulomb constant](#);
- R_K is the [von Klitzing constant](#).

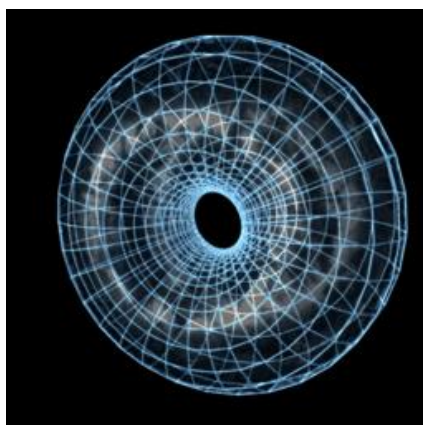


Theodor Kaluza

Oscar Klein

Another view of α is: the quotient of the minimum angular momentum allowed by relativity for a closed orbit, and the minimum angular momentum allowed for it by quantum mechanics. All this points to Charge being a geometric property of space - a feature of the Hilbert correlations in the E-Space. That is why Kaluza-Klein could describe the Electromagnetic field, driven by charge, via an additional dimension, with light being ripples travelling in the fifth dimension.

Kaluza had started out by applying Einstein's formulas for general relativity to an additional dimension, and derived new equations for that 5 dimensional set (4 space and one time dimension). Surprisingly, the additional equations he found were none other than those of Maxwell describing Electromagnetism! Kaluza immediately saw the connection- Gravity and Electromagnetism are associated with ripples in space time, each in a dimension of their own. He saw that what we measure as electromagnetic fields might be merely an underlying curvature in the invisible fifth dimension (which Klein later compactified).

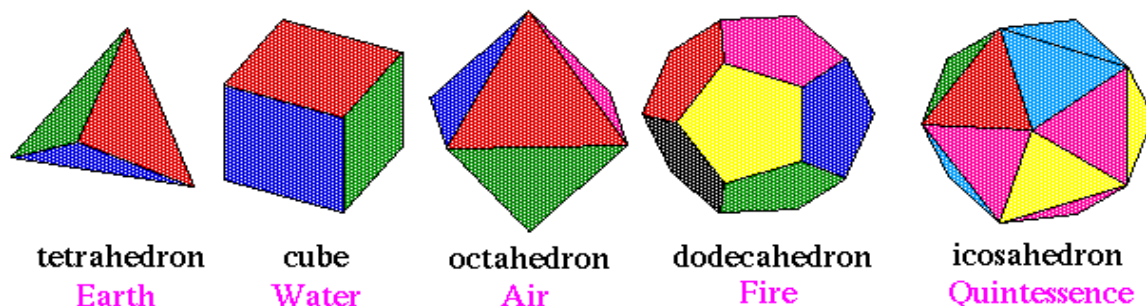


Einstein was excited at first, cooled off, then warmed up to the idea again and kept entertaining it on and off the rest of his life. Others pursued it, but dropped off when the results didn't immediately match experiment, and when they got busy with the latest mystery at the time, Quantum Mechanics. Perhaps a more dogged pursuit would have paid off (String theory picked up the thread much later, with many more dimensions, to describe more of the forces like the Strong force and Weak force) – Perhaps Einstein should have given them the nudge- after all, ***His own*** first calculations for General Relativity were off by a factor of 2 for the deflection of light (and if Eddington had verified it earlier before Einstein made the correction, it would have also been discredited – after all, Soldner had predicted the same wrong value 115 years earlier). This was another idea, like his General Relativity, where he should have said: “I Feel Sorry for the dear Lord, because the theory is correct”.

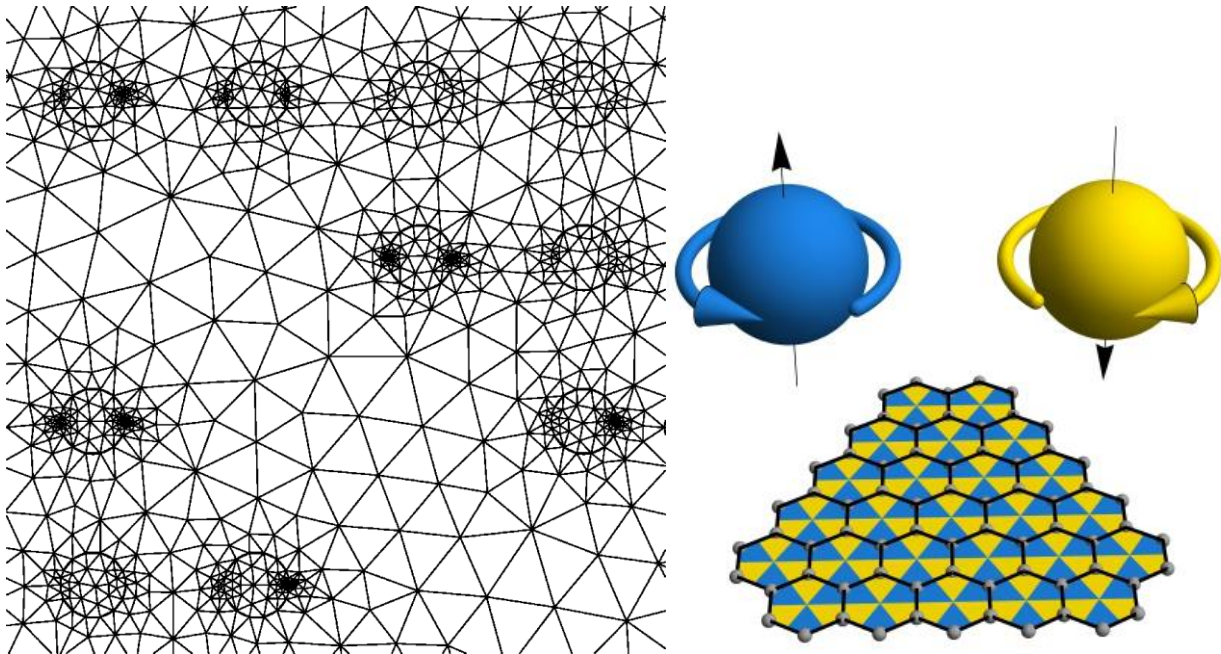
Much later, String Theory would postulate that charge is related to the number of windings a “wrapped” string requires to disentangle itself in the allowed patterns of vibration in the multiple dimensions of M-Theory (a parallel to our trapped photon resonance picture).

Ultimately, Physicists are starting to see Charge as just another Color (in addition to the Red, Green and Blue of Quarks), all dimensional features of space geometry, with their own Gauge Symmetries (unified by SuperSymmetry). A sort of synergy starts to emerge from these “color” dimensions and the extra dimensions of String theory. The Symmetries of Geometry (circle for QED, Sphere for QCD, etc) provide the rules. Gravity (Relativity) and EM (interchangeable electric and magnetic forces), both observer dependent, are guided by the same element, the speed of light, which draws out this geometry.

The five Platonic solids



In our rotating photon electron, it is the topological configuration that leads to charge. A “new topology forced by the rotation ... re-configures the internal electromagnetic wave to exhibit an external charge” (Williamson). Geometry rules, just as the ancients thought, from Plato to Aristotle to Kepler, if for other reasons than they thought. Descartes would not “accept or desire any other principle in Physics than in Geometry or abstract mathematics, because all the phenomena of nature may be explained by their means”. Abbot’s Flatland lesson is hard to learn, and is easily unlearned, when the concepts involved contradict our 3-dimensionally constructed intuition.



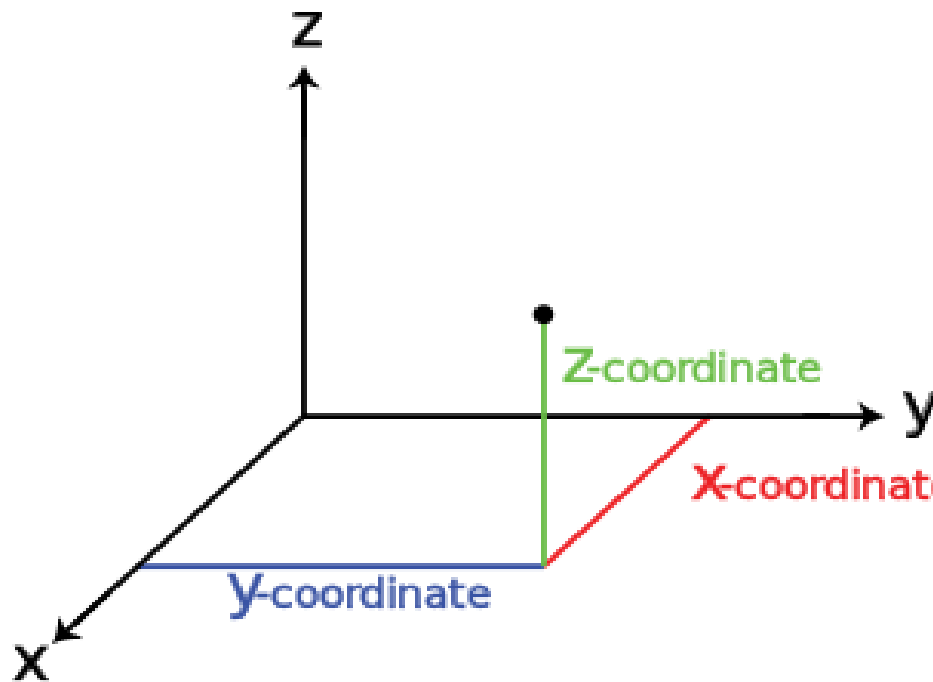
Takeaway: Charge is a geometric effect, like Gravity, a result of the EM energy in a 5th dimension.

4 - PL WORLD

"But what's the particular go o' that?" - James Clerk Maxwell

"A 'pregeometry' that is primordial chaos, and law built upon this chaos: that is the vision of physics that we are led to examine". - John Archibald Wheeler

If we take a Pilot Wave picture of QM as the key to Quantum behavior and non-locality, where does this lead us?



I picture a world of three apparent dimensions of space, the one we “see”. In this world, there is no such thing as “matter” matter. Matter is an epi-phenomenon from EM waves and other color waves, arising in separate dimensions not “visible” to us, but impact us never the less (not least because we ourselves are made of them and live in those dimensions).

Light is an oscillating PL cluster in a separate dimension (either two orthogonal ones, or a circular dimation). This light moves in “straight” lines along the 3-D nodes of our space, at the “speed of light”, which is defined as fixed by convention. This pre-definition results in the effects we call special relativity. The speed of light is not a “Speed Limit” of the Universe, only just for us. It is the speed that remains invariant under certain Lorenz transformations of the reference frame. As it turns out, that provides a limit on transmission of information for us, but not for guide waves or PLs.

The motion of those clusters is “guided” by pilot waves, Bohm’s “active information”, being “a form having very little energy [that] enters into and directs a much greater energy. The activity of the latter is in this way given a form similar to that of the smaller energy”.

Electrons are easily seen as trapped photon loops, also in that dimension. They also move collectively in our 3D space. A similar view can be made for quarks, protons, neutrons, which also include EM-like “color photons”, also in trapped formations. All of those structures are formed by PLs, building up in the dimensions of the Hilbert Space.

So what does the 3-D space contain (other than those photon and “matter” clusters riding on their nodes in the extra dimensions)?

First it contains individual PLs at the 3-D space nodes, creating the space mesh. This is the “Vacuum”. This Vacuum is the “infrastructure” on which PLC clusters move, the “Highway of Reality”.

Next, it contains the wave-functions of the clusters in the higher dimensions. These wavefunctions are fields, made of PLs, that “guide” the motion of the clusters of the other dimensions, using the Pilot Wave Mechanism of the De-Broglie Bohm theory. Those waves exist objectively in 3D space, mathematically represented by the “configuration space” picture which ties them to the actual particle clusters themselves. They exhibit the usual wave properties of reflection, transmission, diffraction, interference, etc, as well as linear superposition. The Wave-function – the “State Vector”, is the so-called gravitational Vacuum, the carrier of the gravitational “force”.

So the 3-D space contains the guiding rules for the behavior of the other dimensions, therefore providing the kinematics and dynamics of the entire structure. The Photons and Particles are the vehicles, and the 3-D space is the highway and the map.

The “warps” and “curves” of General Relativity (which apply to “Matter” and “Energy” of all forms, EM, color or otherwise) are the warps caused by the amplitude of the clusters in the other dimensions.

The “Forces” are a result of those warps in the structure, geometric impacts as explained by General relativity, generalized to the EM magnitudes and Color magnitudes, which represent “Matter” or “Energy” in this context.

The Trajectories taken by those clusters in their motion are then guided by the wavefunction in 3-D space, following the rules of probability of the guide wave, which defines the optimal path (resulting usually in the “least action” path being taken, the geodesics of gravity being an example). Those waves guide the particle by their “form”, not their intensity, using their active “information” (phase, velocity, etc) to guide the actual trajectories of the “massive” particles, with those particles again affecting the wave structure. Information is the key in a digital world.

We are beings of “Matter”, really “Energy” if we call EM and Color Photons Energy, in the extra dimensions, located at the points in 3-D space, moving along the points in 3-D space, which we see as our “space” since kinematics, motion, is what defines the world, and those kinematics happen in the 3-D space, the map of our world.

Reality is then this “space” and “matter”, all defined from the same “stuff” (PLs), with “time” tracking process and change.

We define the “straight lines” of this space by the paths taken by our “visual tool”, Light, itself guided by the pilot wave of its QM wavefunction.

We define the space by the relationships built by those straight lines, creating a mesh (built on the space-mesh structure, the “Ether” resuscitated).

We define Time by the causal relationships defined by interactions of clusters that intersect in this 3-D space.

We measure the space between those interactions by “assuming” (defining) a fixed speed of Light, the yardstick for our measurements. Once we define this yardstick, we find that all EM propagations go at this speed, hence becoming a defacto speed limit for everything we see, since it is made of this stuff. Slower speeds of Matter result from non-linear motions of rotating clusters.

The effects of rotating clusters, aside from resulting in slower propagation speeds, also conspire to provide the “Lorentzian” effects of motion, giving the results of Special Relativity proposed by Einstein (and simultaneously by Lorenz and Poincare)– a valid theorem, but with a different interpretation than adopted by Minkowski (and later Einstein).

The Hidden variables of this world are hidden in plain sight. The Guide wave is riding on our vacuum (our 3-D space) but not observable (because we see

only with EM light, in another dimension). The Particles we actually “see”, however, are in those hidden dimensions! How is that for a divine parlor trick.

This picture does not contradict any of the valid laws that have been extensively verified by experiment: Special and General Relativity, Quantum Mechanics, QED, QCD and the Standard Model. It simply provides a “picture” of the world in which they are built.

The “novelty” is only in accepting interpretations (themselves old interpretations, in fact, the ORIGINAL interpretations) of Relativity and QM which were postulated by Lorenz & Poincare (before Einstein) and by DeBroglie (before Bohr). Those ideas were even anticipated earlier by many, like Grassman, Hamilton, Clifford, and many more.



Euclid's “Elements”

The Benefit is to provide a consistent, simple, unitary view of Nature composed of Logical PL entities at all levels. It provides a view that explains the “weirdness” of QM, non-locality, the measurement problem, and entanglement. It creates a “reasonable” world again, something we can visualize and understand. A flat expanding world, but one that Euclid would have recognized.

Things are again what they seem to be!



What if things are pretending
to be what they really are...?

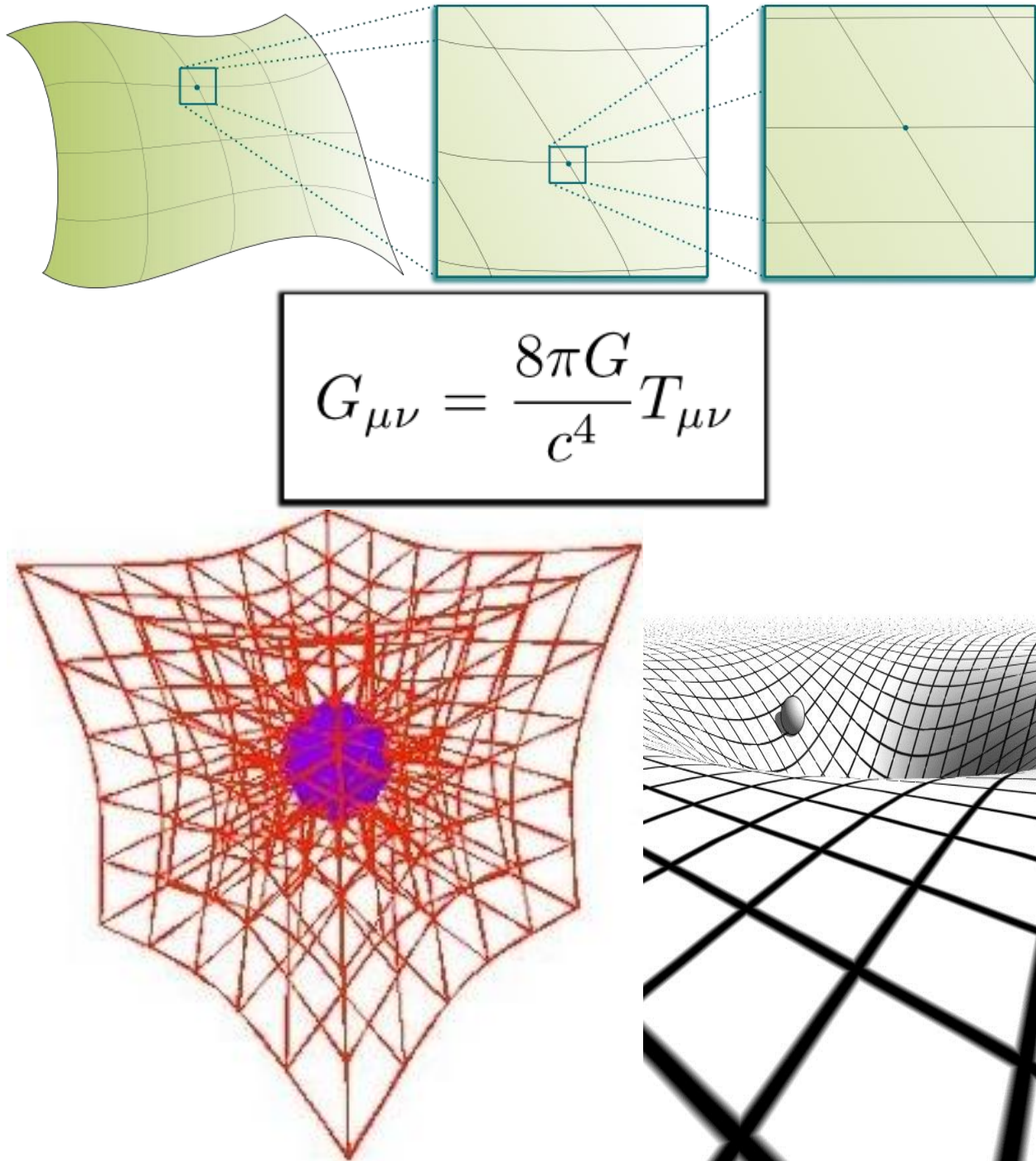
4.1 - THE LIFE OF A PL

Let us take a qualitative look at a day in the life of a PL.

- When a PL is first born in our world, it creates a node in the space-time mesh. A decision in the chaos flips to YES, creating another logical instance, that can now interact with the rest of the existing space-time mesh. This node results in a (very slight) expansion of space, simulating a “negative pressure”, and bringing with it its “energy”, to add to the “vacuum energy” of space (which is made of the PLs themselves, that are its energy).
- This PL then commences an endless series of dips into the void of the Netherworld (the logic of NO), to re-emerge at the “next” node already created by another PL. It propagates in a straightline (actually, its “motion” defines “straight line” for us), as do all the other node PLs in the Mesh. A constant churn of creation/annihilation in the “vacuum”, that goes unnoticed – primarily because at any “moment” the mesh is full of PLs, that have interchanged places in their motion.
- The PLs in this “vacuum” 3-D mesh can move at ANY speed, unrestricted by our speed of light, which has not made its presence yet. This gives the “vacuum” its non-local character.
- As those PLs move about in their random flight, various phenomena familiar from Gas Dynamics, Brownian Motion, and energy fluctuations start to occur. Groups of PLs would arrive simultaneously at a node, creating a “higher” density of PLs, reflected as a warp in the “mesh”.
- Those “warps” of the mesh can take many shapes and forms, depending on their value. As in Gas Fluids, the peaks in those fluctuations can be much larger than the “average” density. Higher Warps also create an “attraction point” for other PLs (a gravity like effect from the warp), accentuating the peak.
- One form of those peaks could be the axions that would represent Dark Matter.
- If sufficient PLs accumulate at a node, the PLs start distributing in “multiple dimensions” around the node in the Hilbert’s space of their making. One such dimension we call the EM dimension, others the weak and strong color dimensions. Even as the PLs go into those other dimensions, their “warp” effect on the 3-D space mesh still shows, their “mass” effecting a gravity-like impact on the 3D dimension.

- When the PL “density” in the EM dimension reaches a critical level, a cluster motion may commence, with the PLs moving in unison along the mesh. This ordered motion of a cluster of PLs represents the creation of a photon “particle”, virtual or otherwise.
- If the density in the EM dimension is sufficiently high, a “tension” in that dimension (which is relatively compacted) starts an undulatory motion (familiar from Fluid Dynamics) of the PLs in that dimension, which we see as EM radiation. The dynamics of the undulatory motion, under the tension in the EM dimension, results in the PL cluster moving forward at a synchronized rhythm and speed, which we define as the frequency and speed of light. Remembering always that even as those clusters move, each PL is being annihilated and recreated at every click of the mesh, and we can interpret this as the whole “photon” cluster being annihilated and created.
- These clusters are relatively stable, like the water waves along the Edinburgh-Glasgow canals that gave us the Korteweg-De Vries equation (related to Yang-Baxter equation), Non-linear motions that still do not disperse. Non linear versions of Schroedinger’s equation produce dynamics where the state vectors directly describe physical reality, where point particles are replaced by tiny wave packets.
- This moving cluster of PLs, in the EM dimension, moves in a straight line, until it hits another PL cluster. Several things can happen at that point, including creation of “matter” particles, reflection/bounce, or “absorption”. Let us look at these one at a time.
- First, what is a “collision” of PLs or PL clusters? As the PLs move (alone or in clusters), they may show up at the same node. This is a “collision”. Since their basic mode is to continue clicking on to the next node, this could potentially be a non-event, trains passing in the night, ghosts immaterial not feeling each other. However, the presence of more than one PL at a node creates a “warp” in the mesh, messing up the concept of “straight line” that the PLs were following. Where to go next?? Follow the “new” straight line created by the warp. More fundamentally, the “warp” represents a “metric field”, a “wave guide” a-la-Bohm, which tells the PL where to go next. By this warp, the PLs “feel” the collision, and get redirected. The structure of “Space” is encoded in the metric field.
- This Metric field is a complicated one, granted – it would include Einstein’s Stress-Energy Tensor (which accounts for momentum, mass

and pressure), as well as equivalent “tensors” for EM/Weak/Strong dimensions (a-la Kaluza Klein), but, once Nature is done with the Math, would be the guide for our PLs.



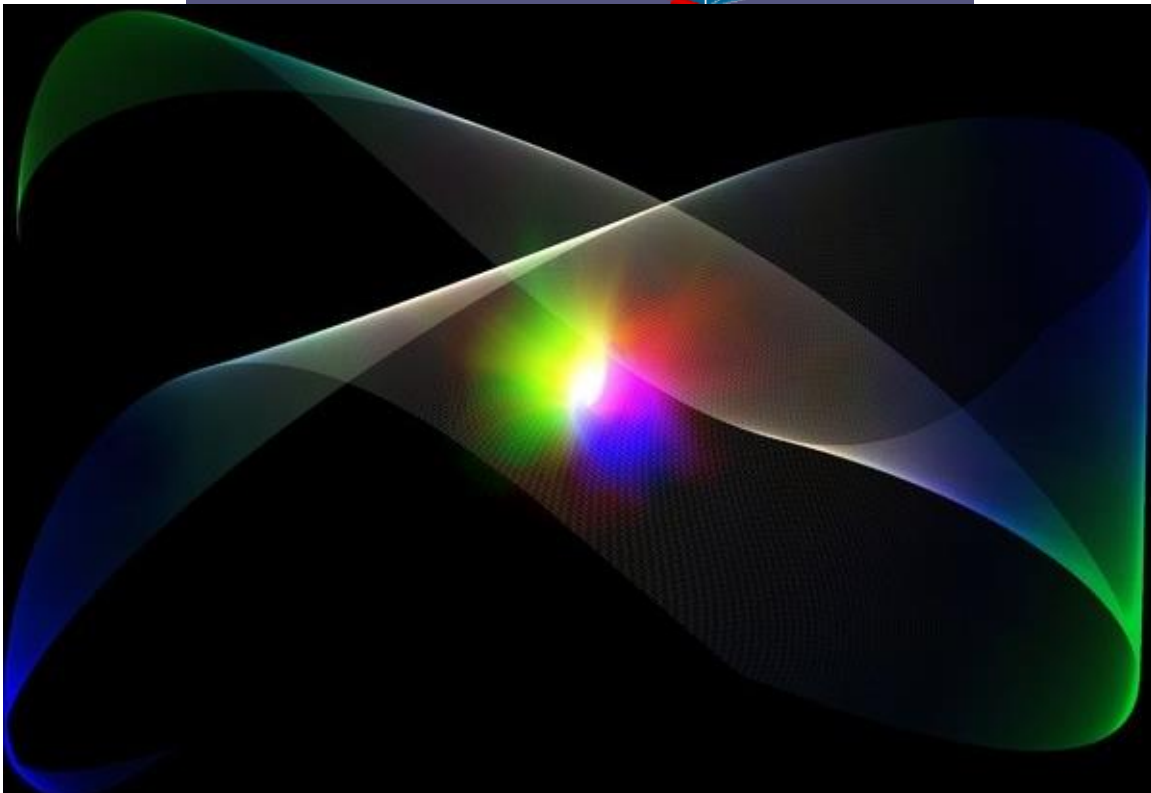
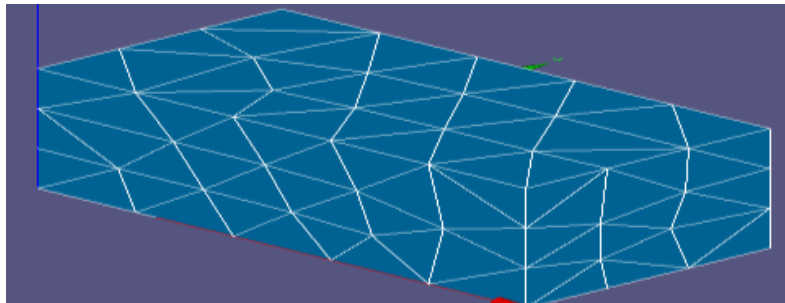
- If the impact of the cluster results in a “curling” of the motion of the cluster, in such a way as to create a spinning cluster rotation, then we

have “created” a matter particle, the electron being the lightest of those. This particle would be spinning in the mesh, while also experiencing translational motion, depending on the cluster formation, and the additional PLs it may carry, moving it along the mesh (kinetic energy!) as it rotates. Typically, to preserve the original “momentum” of the random PL formation, two such clusters form, moving in opposite directions, visualized as particle-anti-particle creation.

- If the PL cluster gets “absorbed” by the other cluster, it will impart its translational motion to that cluster, while incorporating its PLs in the formation of that cluster. That impact translates into “momentum” and “energy” transfer to that cluster.
- If the field warp is substantial, the re-directed motion would look like a “bounce”, and the cluster moves in a different direction, that direction being determined by the guiding wave resulting from the field warp.
- So there you have it: Our PLs create the 3-D Mesh (Space) and expand it (Vacuum Energy), they cluster into formations (like Axions of Dark Matter, or Photon formations), they move about by simple rules, providing us a sense of Time (the Photon speed and rhythm), and in their interactions create rotating clusters (like electrons, quarks, etc.) in the extra dimensions of colors and charge. Voila: QM, QCD, Standard Model, General Relativity, Guide Waves, and the basic rules of Physics. From there on our brilliant scientists and geniuses have taken over, and provided our modern science.
- And if the PL mesh is space, and if the geometry of this space is the particles/mass/waves of reality, then all the “mysterious” concepts are concepts of this space. “Entangled” particles means entanglement of their previously isolated space mesh; “measurement” means pinning down the isolated particle in the macroworld mesh. Pilot Waves are warps in the space directing the motion of “particles” (warps in the other dimensions). Uncertainty springs from both the discrete nature of this mesh, as well as the quantized nature of its warps. Probabilities and uncertainties also spring from the isolated versus correlated parts of this mesh, being composed of a large fabric with isolated patches not aligned with it until interactions take place. Space is IT.
- It is almost as if a 3-D game of “Life” is being played on a child’s computer, with very simple rules: PLs pop, move in straight lines,

accumulate, warp the space, and keep moving accordingly. The resulting amazing “Universe” they build is our Universe.

- One note on the Beginning: At the first Node, new PLs had only one place to go, and they simply piled on – the Singularity. No time, no space, just additive logic. When the next node came along, the PLs had somewhere to go, and started moving back and forth. As more nodes came about, Nature got good at the game, and “Space” spread with a bang. A Big Bang! Space was born, and the warps of this space were called “things”, or matter. As things bumped in Space, their interactions defined time. Time is born. Out of the Chaos, a Universe was born. Some of those warps eventually combined to form DNA, and eventually intelligent beings were born. And in time, some of those beings wondered how they got there... and an idea was born.



4.2 - SPEED LIMITS: “C” IS FOR CELERITAS

The Speed limit of our Universe is **NOT** the speed of Light. Life would be simpler if it were, but it is not.

That speed limit is the speed limit of Light itself (obviously), and of “material” objects like us. But we’re not all there is, not by a far shot.

Take the Gravitational Field, for example. How fast does a disturbance in that field propagate? The “standard” answer is: the Speed of Light. But if you look at all the equations of General Relativity, you will not see the delays due to a finite speed of light in the equations. Rather, if you look carefully, there is an implicit assumption of instantaneous propagation.

True, the hypothesized “Gravitational Waves” (recently detected) are said to move at the speed of Light, but this is not the same thing as the speed of the Gravitational Field. Gravitational waves are specific emanations in asymmetric, accelerating, very massive objects affecting space-time, small fluctuations of curved space-time that have separated from their source and propagate independently as ripples *of* space (and not *through* space). The Gravitational Field is our daily bread and butter. The Gravitational waves result from a body’s inertial mass, and are determined by the permeability and permittivity of the space-time medium, caused by acceleration (whereas the Gravitational Field causes acceleration).

But the equations of GR, which tend in the limit to Newton’s equations, “assume” an instantaneous transmission of the gravitational influence. In fact, any delay assumptions would cause catastrophic increases in angular momentum, incompatible with observations – something recognized early by Eddington and others. Einstein himself made no mention of a “speed of Gravity”, only of Gravitational waves – not the same thing. The equations require the potential field of all bodies to act from the bodies’ instantaneous direction, with no retardation effect, effectively setting the propagation delay of the “gradient” to zero.

There are several experimental indications that the “speed of Gravity” is much higher than the speed of light, by a factor of as much as 2×10^{10} . One indicator is the 40 second delay between the Moon and Sun’s gravitational alignment and the maximum eclipse. Another is the lack of observed Gravitational Aberrations similar to the Aberration of Starlight, resulting in

specific effects on the Sun's dust disk – the so-called Poynting-Robertson effect. As far back as 1825, Laplace recognized this effect, putting a lower limit of 10^{18} c on the transmission of Gravity, to prevent the effect from accelerating the Earth (a net doubling in 1200 years, clearly not observed). More recently, the US Naval Observatory and the Development Ephemerides of the Jet Propulsion Laboratory showed the earth accelerates toward a point 20 arc seconds in front of the visible Sun, where the Sun will appear to be in 8.3 minutes – i.e. to its actual rather than visual position, reflecting a quasi-instantaneous effect.

Recent experiments by Walker & Dual have tentatively measured faster than light propagation of gravitational and electrostatic fields. As Feynman had showed in 1963, analyzing the electric field of an oscillating charge, the oscillating field propagates nearly instantaneously along the axis of vibration, much faster than the speed of light, and others concluded the same would apply to an analogous oscillating mass and its gravitational field. This was a result of the normal EM equations and Feynman confirmed that it did not result in any causality violations. Walker and Dual showed that calculations point to phase speeds of longitudinally oscillating electrical and gravitational fields as being “too large to be measurable with a laboratory experiment.” Their calculations also showed that the Group velocities, commonly thought to be equal to the speed of light, are also faster than the speed of light in the “semi-near-field”, “which appears to violate causality and should not be possible”, hedging their bets by saying the analysis is “currently inconclusive”. Thomas Chen, one of their collaborators, indicated that this does not necessarily imply a violation of causality. This is because the transmission of information requires more than a single wave, and requires a fourier transform over time, but with sophisticated techniques, “It is never possible to tell”. He points to a Heisenberg Uncertainty-like principle: “the more spectral content a transmitted signal contains, the longer one has to measure it for an accurate fourier analysis, and the farther away from the source one must move in order to determine the propagation speed of the signal.” Sommerfeld and Brillouin had already demonstrated that the information is in the “front wave”, and not in the pulse maximum, minimum or envelope, but in the “singularities (points of non-analyticity) of the pulse” (Mojahedi & Malloy). The “Front Wave” speed is always at a “front velocity” that is luminal. So although we have superluminal phase and group velocities, no violations of Special relativity or causality occur.

Measurements of the transmission of gravitational effects in Binary Pulsars also indicate superluminal effects. Explanation using “retarded potentials” may be just that – retarded. It is important to mention though the Kopeikin-Fomalont experiments which measured the field speed at close to c by observing Jupiter’s gravitational field effects. More work is needed to clarify the contradicting measurements, and verify the underlying principles of what is being measured – many, like Flandern, Asada, Nordtvedt, Faber, Will & Samuel (Lawrence Berkeley National Laboratory) think what is being measured is the speed of light effect, and not the “speed of gravity”.

Black holes are another hint at this: how can gravitational effects (gravitons?) of a black hole travel out of the Horizon if they travel below the speed of light?

This picture is in line with our PL proposal. Light is a special cluster of PLs, traveling in a specific dimension, with a particular speed. It travels on a fabric of space, built also by PLs, in the 3-dimensions of space. The Gravitational Field (like the Quantum field, the Pilot waves), rides on this 3-dimensional “Field”, whose PL components are NOT restricted by the rules of Light and its speed. Those fields have to be dynamic, not frozen in time... more like flowing rivers, at very high speed, in order to propagate the influence across the mesh. While the PLC Photon and matter clusters move at c or below, the “map” itself can change faster than c . The speed of the “vacuum”, the carrier of non-locality, is much faster than c .

While some see this as a conflict between the geometric picture of GR and its field formulation, in our picture, the Field is itself the Geometry of space, and hence no contradiction occurs. The effects of this field (basically geometric changes) can travel much faster than the speed of Light. While Causality would tilt against infinite speed/ instantaneous transmission, the speed can still be much larger than c if no “information” is transmitted. Feynman had mused that “it is one of the peculiar aspects of the theory of gravitation, that it has both a field interpretation and a geometric interpretation”.

As we have seen elsewhere, this is also true of the other forces as well. It has also been shown that Electrodynamic effects (not the light corpuscle itself) can travel faster than the speed of light, with experiments at the NEC Research Institute in Princeton claiming speeds up to $310c$. The Keller group in Switzerland has measured electrons tunneling in practically “zero” time. Nimtz and Stahlhofen in Cologne also claim FTL photon transmissions in gaps

between Prisms as far as 3 ft apart, involving evanescent modes, as well as transmitting Mozart's 40th Symphony through a 12 cm barrier at 4.7c. While those experiments lead to controversial interpretations of what is actually transmitted, and may not be able to send "information" faster than c , the effect of two accelerating charges on each other seems clearly to flout the speed limit. Similar efforts by Sherwin and Rawcliffe, Obolensky, Podkletnov & Modanese, Phipps, Brumfiel and Graneaus point in the same direction.

The FTL Gravitational Speed could help explain a lot of the non-locality issues of QM, and other conundrums. It does not conflict with General Relativity, which stays intact. It does challenge Special Relativity in its Einstein interpretation, while keeping in line with the Lorentz interpretation, which is effectively the same phenomenologically. This Lorentzian Relativity provides a Universal Time, and a reference frame (being the gravitational field, as Beckmann had suggested), bringing a stronger "reality" into the world picture. It may be also the basis of Eddington's "refracting" medium.

The challenge to SR is not a new one. As we saw earlier, John Bell advocated a return to Lorentzian Relativity as a way out of the non-locality issues demonstrated by EPR experiments. Many leading lights had tipped in early, including Sagnac, Michelson, De Sitter, Ives and Stilwell. The confusion over the status of the Ether, the (unfounded) assumption that GR is based on SR, and the lack of clarity on the wave-nature of matter may have exacerbated the debate in favor of SR. Eventually Einstein veered towards a field picture, and re-habilitated the "new" Ether. Perhaps a marriage of SR and Lorentzian concepts can be made in the framework of the PL picture, where the dilation effects can be explained in the PL field warps in the context of the PL Ether.

Indeed, many theories are proposed to address the flood of evidence for FTL speeds. Potential Lorentz symmetry violations at Planck scale in the Standard Model Extension (SME) proposals introduce many new effects, including FTL speeds. Some models visualize particles with critical speeds different than c , and see those as the ultimate constituents of matter (our PLs??). Other models based on the EPR paradox suggest a preferred absolute reference frame, based on this superluminal speed, allowing simultaneity, absolute space and time and a deterministic universe along with decoherence. Other models feature the vacuum as a quantum superfluid (SVT or BEC theories) (our PL Fluid?) which is non-relativistic, and hence allowing FTL speeds. Doubly

Special Relativity (Amelino-Camelia and Magueijo) posits a fixed planck length in all frames, allowing variable speeds of light, and faster than c speeds.

Amelino-Camelia infers the granularity of space-time from the abundance of high-energy cosmic rays, which effectively “hop” the mesh thereby losing less energy (and covering less “distance” effectively) than lower energy rays.

This Faster than Light speed of Gravitational as well as EM fields, whether interpreted as group velocities, phase velocities, or PL mesh curvature spread, helps explain the quasi-instantaneous effects of gravity, looking like Einstein’s “Spooky Action at a Distance” that also worried Newton. It can also apply to the quantum field propagations, which would explain the Pilot wave effects, non-locality, and much of what we have already discussed. SR itself never forbade FTL speeds – it just said you cannot accelerate to c , since that requires infinite energy. A constant speed of Light is a tautology, a conventionality, since we define distance and time via Light, and we only measure a closed path speed, one way speed being unmeasurable. Specifically, c is a conversion factor for changing a unit of time to a unit of space, making it the only speed which does not depend on the motion of the observer or a source of light. But if you are already going FTL, like a tachyon, then more power to you! Light is a “two-way barrier” (Khalili), but you can be on either side of it. A PL can be seen as a tachyon which has lost its energy, and can travel at near infinite speed. String theory allows gravitons and “sterile” neutrinos to go faster than light through extra dimensions.



Neutrinos detected at FTL speeds in Gran Sasso?

Experimental detection of FTL Neutrinos are still controversial, but Alan Kostelecky & Alan Chodos had already proposed potential Lorentz and CPT violations at the Planck scale being possible causes for neutrinos masses and oscillations, and possible FTL effects. The Scharnhorst effect is another FTL

quantum phenomena for photons displayed between two close plates (a-la-Casimir effect).

One more viewpoint to consider: It is often considered that, to obey SR, locality has to be preserved. And to act non-locally, additional dimensions have to be invoked. So here is a picture to consider: Matter, and Light, are all in the EM and Color Dimensions. In those dimensions, they obey the speed of Light, and SR applies – no information faster than light, no “Bell Telephone” (as in John, not Alexander). Our 3-dimensional world, where (in our PL view) only wave functions and Gravitational effects live as directions on the highway of “space”, is the “Additional Dimensions” of non-locality! Their superluminal speed for wavefunctions and Gravitational effects is what carries the non-local effects of the particles and photons, who themselves obey the “c” speed limit. The Sun “knows” where Earth is right now, not 8 minutes later when it shines on it. It “sees” it first via Gravitation in our speedy 3-D space, before it sees it with its light in the slow EM dimension.

Overview and comparison of SR and LR (from Flandern)

Attribute	SR	LR
postulates	1) all inertial frames equivalent 2) speed of light unchanged	classical physics applies
equations	$t = \gamma(T - vX/c^2)$; $x = \gamma(X - vT)$ $T = \gamma(t - vx/c^2)$; $X = \gamma(x - vt)$	$t = T/\gamma$; $x = X$ $T = \gamma t$; $X = x$
physical effects	time dilates, space contracts, momentum amplified by motion relative to observer	clocks slowed by motion relative to local gravitational potential field
special feature	space and time are physical entities that can be altered by motion	space, time are dimensions/concepts, not material, tangible entities
light speed	constant by postulate	varies with observer motion
distant time	no remote simultaneity between frames	universal instant of “now”
motion	all motion is relative	motion relative to local gravity field

The dilemma revolves around varying interpretations of the phenomenology of the Lorentz-Fitzgerald effects. It marks the split between Einstein’s 1905 Special Relativity (SR) interpretation and the Lorentz Ether Theory of 1904, or Lorentz Relativity (LR), with SR denying the need for a preferred frame, while LR affirms a universal Ether (to be identified with the local gravitational field). De Sitter, Sagnac, Michelson & Ives sided with Lorentz, and LR was

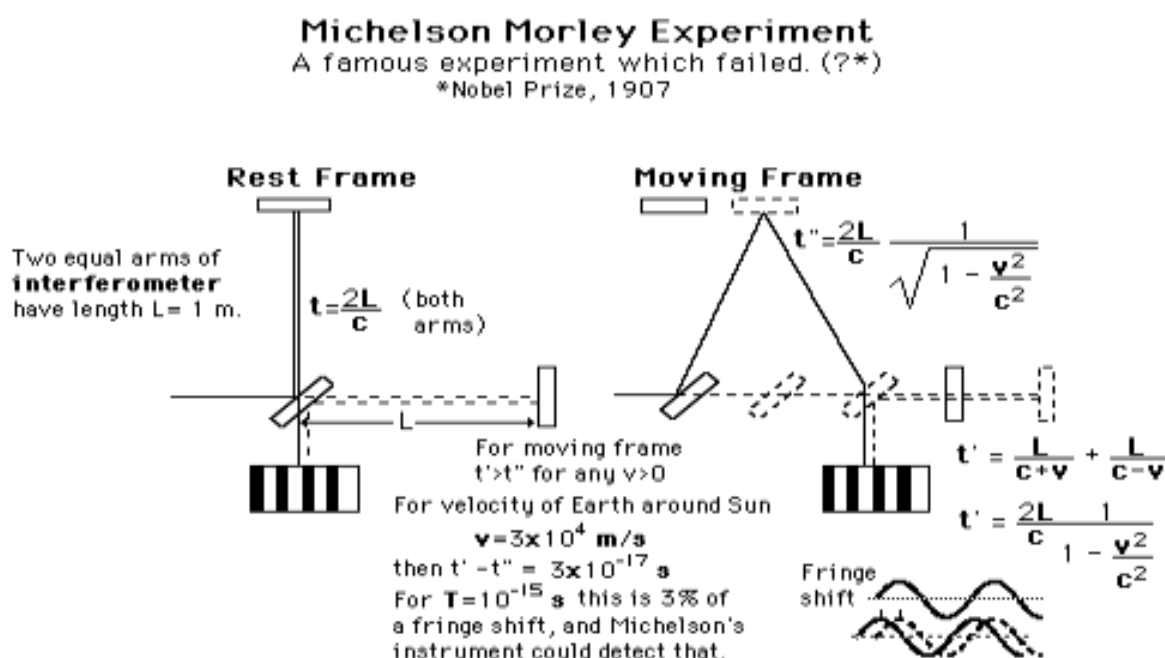
further developed by Tangherlini, Mansouri & Sexl, Beckmann, Hayden, Hatch & Selleri.

The interesting thing is, interpretation apart, both approaches are phenomenologically identical. Experimental verification to date of SR means simultaneous verification of LR. Only experiments proving faster than Light action can validate the difference, since LR does not have a speed limit. In LR, the speed of Light is like the sound barrier... something hard to beat with a propeller plane, but easily overcome with a jet plane. In SR, The speed of light is simply declared “invariant”, and not a “speed limit”, with tachyons a distinct accepted possibility. SR is a theory of invariants (Einstein’s preferred description), distinguishing “relative” terms (such as lengths and times) from those that are not (like proper times and rest masses), without setting limits, although the Light Speed limit comes out of the energy requirement to reach it. SR limits the transfer of “Physical Influences” faster than light, meaning large energy/matter aspects, and not the tiny PLs of the space mesh.

In a sense, the battle may be one of tautologies. If we adopt Einstein’s clock Synchronization methods, SR postulates come out Naturally. If we adopt Lorentz’, we have a Universal time, and SR *postulates* fail – but NOT THEIR RESULTS! Even today, our GPS systems use a Lorentz approach to synchronize their time against a “local- universal time”, and the results work out either way, with LR being easier to work with in this case (including programming varying light speeds on the surface of the Earth). The Robertson-Mansouri-Sexl test theory introduces a preferred Aether frame. Even General Relativity (GR) is built on SR with one-way LR transformations relative to the local gravitational potential field (center of mass reference frame), which is our Ether, the Elysium, the Light carrying medium. So GR is basically consistent with an LR version of SR!

The one experiment that “falsified” LR was the Michelson Morley experiments. But as we have discussed, a Superfluid Universe picture leads to the entrainment of the the “Elysium” field by the local gravity field, which would then lead to the expected results of the experiment. De Witte, Torr & Kolen, and Miller’s experiments, properly re-interpreted, show that “Ether Drift”. One way Light speed measurements and other tests (S. Gift, Shtyrkov, Marinov, Galaev & others) also hint at an absolute frame, while keeping SR’s prediction intact.

It seems that both LR and SR can be accommodated as two faces of a coin, when the proper terms of “speed of Light”, and Reference frame are defined. A superfluid Universe picture, a PL world, provides the dynamic space-time reference of Lorentz, while supplying the varying time/space vistas of SR. The definition of motion (PL hops) versus time (PL free resonance in place) provides an explanation for the dilation effects.



The “peaceful coexistence” (Abner Shimony) between SR and QM has been maintained with the help of the various “no-signaling” theorems, ensuring no information travels faster than light (Eberhard’s theorem), while correlations carried by the non-local field can still break the speed limit. As long as non-locality is un-controllable (i.e. only Outcome dependent, and not parameter dependent), and no superluminal signaling is allowed, the peace will hold. QM bought this peace at the price of “patches” in local quantum field theory, providing for “micro-causality” or “local commutativity” (Bohr, Rosenfeld)-space-like separated observables (outside each other’s light cones) must commute even if QM normally says they don’t – a problem in waiting for QM (or Relativity), as recent proposals by Aharonov, Anandan, Maclay and Suzuki might suggest.

The phases and gradients of the Gravitational and EM & QM fields can vary superluminally, but gravitational waves and EM waves (including particles) that carry energy (and potentially information) cannot.

This superluminal influence is inherent in Quantum Mechanics. As Henry Stapp says in relation to Bell's inequalities: "Quantum phenomena provide *prima facie* evidence that information gets around in ways that do not conform to classical ideas. Thus, the idea that information is transferable superluminally is, *a priori*, not unreasonable. ... Everything we know about Nature is in accord with the idea that the fundamental process of Nature lies outside space-time, but generates events that can be located in space-time. The theorem (Bell's) of this paper supports this view of Nature by showing that superluminal transfer of information is necessary, barring certain alternatives that seem less reasonable." The processes "outside space-time" are our PLC clusters in the extra dimensions, and they generate events in space-time which they "ride" on. Such superluminal effects and non-locality are suggestive of an absolute frame of reference, and L. Hardy & I. C. Percival have suggested "double EPR" type experiments to confirm this. Hardy's theorem requires a preferred Lorentz frame, and Hiley and Bohm see non-locality as requiring a particular frame of reference.

This superluminal transfer, aptly demonstrated by Clauser & Freedman, and Alain Aspect, cannot transmit messages (i.e. is uncontrollable), as proved by Stapp, Sarfatti & Herbert, and therefore does not challenge Special Relativity. "... if the ordinary quantum field theory is embedded in this way in a theory of beables, it implies that faster than light signaling is not possible. In this *human* sense relativistic quantum mechanics *is* locally causal" (John Bell – 'the theory of local beables'). Interestingly, Bell compared the wave function and its non-locality to the scalar potential of the Coulomb gauge which propagates with infinite velocity, while relating the quantum 'beables' to the electric and magnetic fields E & H, which are local and causal. The 'funny behavior of the scalar potential of Maxwell's theory' and the wave function is acceptable, since "it is in terms of local beables that we can hope to formulate some notion of local causality" (Bell). QM's creation operators create "a positron at the point x ***together with its coulomb field***" (Dirac), the field appearing everywhere instantly.

"Any localized system, any macroscopic system, any planet, breaks Lorentz symmetry, and causes other systems in its neighbourhood to obey a dynamics with a preferred frame" (Ian Percival). This is the Ether effect – being the gravitational metric of the surrounding space. This broken symmetry would be such that "weak signals can propagate faster than the velocity of light".

Bohm suggests this superluminal speed is what simulates non-locality. “Our ontological approach allows us, for example, to consider the possibility that the current quantum mechanics is an approximation to a deeper theory Let us assume then that the long range connections of distant systems are not truly nonlocal, as is implied by the quantum theory, but that they are actually carried in the preferred frame at a speed that is finite, but very much greater than that of light. For measurements made at levels of accuracy thus far available, the results will be very close to those predicted by the present quantum theory. But if we can make measurements in periods shorter than those required for the transmission of quantum connections between particles, the correlations predicted by quantum theory will vanish. In effect we would thus be explaining quantum nonlocality as an outcome of a deeper kind of non-Lorentz invariant locality.” “In principle the Bell inequality would no longer be violated for there would be no time for the disturbance of one particle to propagate to the other before the measurement was made on it.” (experiments done in Geneva to verify this have put a lower bound on the speed of propagation of such “spooky action” at $2/3 \cdot 10^{27}$ the speed of light – Nicolas Gisin). “...the deeper fields that would propagate these connections locally, we do not propose that these are intrinsically unobservable. We merely say that in the statistical and manifest domain in which the current quantum theory and relativity are valid, these new properties cannot be observed”, the same way atoms were prophesied for 2500 years before being observed, holding out hopes of being able to experimentally verify this (in less than 200 years, he hopes ☺). This “deeper level of reality in which the basic laws are neither those of quantum theory nor of relativity (which latter come out as suitable limiting cases and approximations)” is our PL Fluid universe.

While Bohm sees a Lorenz-type ether theory allowing us to retain an absolute time order and retain Lorenz invariance (with “no way from the experimental facts alone to prove there is no absolute frame determining a universal order of succession”, and within which “there were large scale objects with structures undergoing processes that would change with velocity in such a way as to bring about Lorenz invariance in terms of frames defined through these structures”), he supposes “that in addition to the known types of field there was a new kind of field which would determine a space-like surface along which non-local effects would be propagated instantaneously”, presenting a “hyperplane of constant time as determined in a Lorenz frame. A good candidate for such a frame could be obtained by considering at each

point in space-time, the line connecting it to the presumed origin of the universe.” “We may plausibly conjecture that this frame would be the one in which the 3K background radiation in space has an isotropic distribution”. He thinks this “idea is not only perfectly consistent, but also fits in with an important tradition regarding the way in which new levels of reality (e.g. atoms) are introduced in physics to explain older levels (e.g. continuous matter) on a qualitatively new basis”.

Chew and Stapp also see this universal preferred frame, linked to their “Unique Universal Time” as part of their proposal for a pregeometry of spacetime. They postulate spacetime as emergent from a sea of “vacuons” and “materions”, not very different from our PLs, obeying quantum laws - a FOCK space of causal-graph arcs (combinations of a consistently-oriented finite set of univalued labels), with the vertices representing “elementary events”. “Gentle type” events constitute “vacuons”, while “violent type” events constitute “materions”, with the matrix evolution depending on an integer parameter T , “Universal Time”, which evolution guarantees the “causal” property. “Vacuons in coherent states formed by “gentle events” and labeled by a “classical field” create our underpinning for space in a sense similar to that by which photons create classical electromagnetism”. The PL analogy and the scale resemblance is very clear. A complementary set of labeled arcs is called “materions”, which plays a role analogous to that of charged particles in QED. The analogy to photons is expanded to a “materion phase” similar to the Aharonov-Bohm phase, which is changed by the materion absorption and emission of vacuons – something like our PL guidewave picture being modified by PLs emanating from the particles. The “vacuon field” is not observable, since the vacuons are not localizable and carry no momentum (like our PLs). The analogy continues by the similarity of the models to superconductors and the BCS-Bogoliubov model. “the principal mechanism for the emergence of classical properties, including spacetime, is the same as the one that generates classical properties in quantum electrodynamics, in the regime of large numbers of very soft photons”, whose coupling to conserved charges generates a “coherent state” leading to classical physics. “...the spacetime structure is a structure that emerges from the superposition of these quantum-mechanically generated phases. The three-dimensional spatial structure thus emerges from a primordial quantum structure, rather than being simply an a-priori arena for quantum theory”. Particles are “materion condensates”, “an approximately time-stable, spatially localized *superposition*

of amplitudes belonging to *different* materion clusters”, similar to QED photon condensation into electromagnetic fields. “Local spacetime, ... entangles universal time, but these two notions are distinct”.

Bondi’s definition of “c” as a constant for converting distances in meters to time in seconds is the most conservative view. “In moving, bodies consume that distance-time as well as time” (Pope & Osborne). Distant interactions take place both instantaneously (from Light’s point of view), and at the finite speed of light (our point of view). Distance, as we know it, is an epi-phenomenon, and we have to revise our interpretation of what it means based on our perception. As Gilbert Lewis noted, Light travels no distance in no time, since in relativity it sees the distance it covers compressed to zero, and time stands still. Landscape painting and holograms already show us that perceived distances can be deceiving. If we use Light (which sees no distance or time) as our ruler, how can we possibly project distance and time from that ruler? “‘When is speed not a speed?’ Answer: ‘When it is the speed of Light’” (Pope & Osborne).

With the speed “c” being DEFINED as a constant, Einstein and Poincare were in a (rare) agreement that one way speed of light is not measurable due to clock synchronization issues; only two way measurements prevail, since the motion is relative, and light is the metric. John Bell had indicated that to an “inside observer” (like us), we have no way to tell with conventional probes whether or not the photon speed differs from Unity- from the inside, systems appear relativistic, even if from the outside there is a preferred rest frame – phonons in condensed matter systems a vivid example.

In a discrete world, multiply connected nodes and patches can defy classical mechanistic motion concepts. In a digital world of information bits, formed by interactions and events, a different paradigm exists than the one of “matter” and “particles”. Our standards of time and speed apply to matter, which has the durability and continuity needed for those concepts to be meaningful. The “ultimate particles” that compose it, and compose space-time, operate at a different level not so restricted.

Gerard ‘t Hooft proposes a different, deterministic view of the world at the planck scale. “The most logical domain of physics where one may expect quantum mechanics to become replaceable by a more deterministic scenario is the Planck scale” (‘How Does God Play Dice? (Pre-) Determinism at the

Planck Scale’). He indicates that “it seems quite reasonable at first to try a classical, deterministic theory for the Planck domain. One might speculate then that what we call quantum mechanics today, may be nothing else than an ingenious technique to handle the dynamics statistically”. “... It seems extremely plausible that *any* reasonable theory for the dynamics at the Planck scale would lead to processes that are so complicated to describe, that one should expect *apparently stochastic* fluctuations in any approximation theory describing the effects of all of this at much larger scales”. “... Our theory may have the property that information cannot spread faster than a certain velocity, say the velocity of light, but its quantum states cannot be characterized locally”. He goes on to show that free bosons are in fact deterministic for observables that are invariant under certain gauge transformations; similarly for non-interacting massless fermions, which behave like flat sheets rather than particles. He sees “a Hilbert space for each division of the world into observer and system” (Smolin) (akin to our patchwork space), with the quantum states living on the boundary of the system (akin to our interacting patches) – an idea extended by Markopoulou to encompass dynamical “causal structures” defining that coherent space.

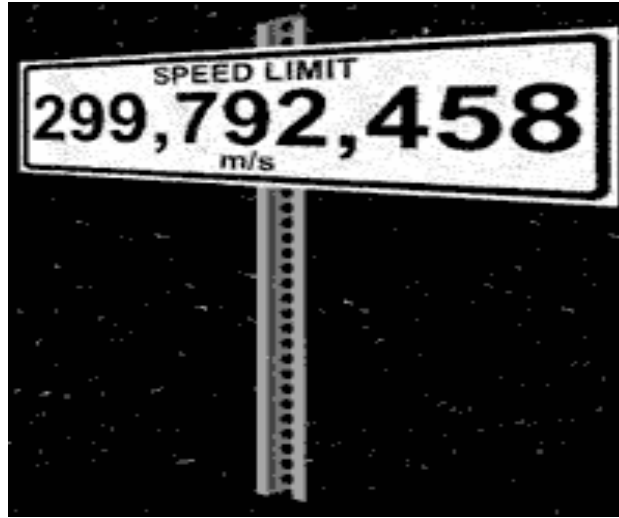
‘t Hooft thinks that “at the level of the ontological degrees of freedom at the Planck scale, there is no local gauge symmetry at all, but in order to describe a physical state, that is, an equivalence class, we need to describe a particular member of this class, a single state. Its relation to the other members of this same equivalence classes could be what is presently called a ‘gauge transformation’”. At the planck scale, our PL level, information gets lost quickly, “replenished by information entering from the boundaries”, while particles (or quantum states) (large numbers of ‘ontological states’ in the same equivalence class) are “defined to be an equivalence class of states all of which have the same distant future”, (our PL Clusters) – a definition that seems non-local and acausal, one reason locality and causality may seem absent at the planck scale, and may also explain why the “the total number of distinguishable quantum states (i.e., the number of equivalence classes) may only grow exponentially with the surface of a system, whereas the total number of ontological states may rise exponentially with the volume” (read holography, entropy). “When we go from the Planck scale to the standard model scale ... Our only way to obtain effective laws of physics at the larger distance scales is by applying the renormalization group procedure”. Andrzej Trautman asks: “can we be confident that nothing drastic happens when we

consider the range of distances from 10^{**} -13cm down to 10^{**} -33 cm...? In this unexplored region there may occur completely new phenomena which will eventually mask over the quantum gravitational effects, as calculated from the present theory". Our 'Ontological state' PL proposal matches 't Hooft's criteria, but is not so 'complicated to describe' ☺.

Franco Selleri (in "Bell's Spaceships and Special Relativity"), building on the work of Mansouri & Sexl, Tyapkin, and Croca & Selleri, reviews alternative postulates, and find "a very large empirical equivalence of all transformations", but sees Bell's example of two equally accelerating spaceships as proof "that absolute simultaneity gives the best description of physical reality". While this example cannot be accounted for in Lorentz Transformations, it is a basic feature of "inertial" equivalent transformations. "Not only does absolute simultaneity arise spontaneously in S, but it provides the only reasonable description of the physical reality". He quotes other situations that support his views, including the case of the propagation of light along the rim of a circular rotating disk, Jupiter Sattelite occultations, Aberration, Radar ranging of planets, and the "numerous convincing experimental proofs that light can sometimes propagate with a group velocity larger than its usual value c " which require the theory of inertial transformations and absolute simultaneity to avoid the "Tolman paradox". He proposes a "new theory in which clock retardation is not a relative effect anymore, but depends only on the velocity with respect to a privileged system. This eliminates all paradoxes of relativism. For example, absolute simultaneity allows one to get rid of the "block universe" paradox discussed by Popper: with the absolute simultaneity all inertial observers have the same present and therefore the same reality. Finally the existence of a vacuum endowed with physical properties (ether) becomes fully acceptable. Naturally the new theory should be checked experimentally, but in a sense its predictions have already been verified, at least in the case of the Sagnac effect".

"If we accept the postulate of relativity, we shall find that among the laws of gravitation and the laws of electromagnetics there exists a common number. It is the velocity of light. We shall find that it occurs in all forces, of whatever origin, and it can only be explained in two ways: (1) Either there exists nothing in the universe that is not of electromagnetic origin; (2) or, this quantity, which is common to all physical phenomena, appears only because it relates to our methods of measurements" (H. Poincare). I propose that both

(1) and (2) are correct. Specifically, our PL world sees all matter and energy as EM configurations. And our “measurements” are tied to rods and clocks which are gauged by the speed of light, which is the speed of the PLC EM clusters that forms them, but not the speed of the mesh that carries them. Aristotle was right in this sense: “time is the number of motion, and without natural body there cannot be motion”. Without the “macro” micro-objects of light and matter, time and space, and hence speed, do not exist.



For Light and Matter Only; Pilot Waves & Gravity please ignore

Takeaway: c is the speed limit of particles and photons. It is not the speed of the ether, or gravity, or the pilot waves. Evidence of superluminal speeds is abundant. This means absolute simultaneity and a preferred frame are possible, without conflicting with Special Relativity.

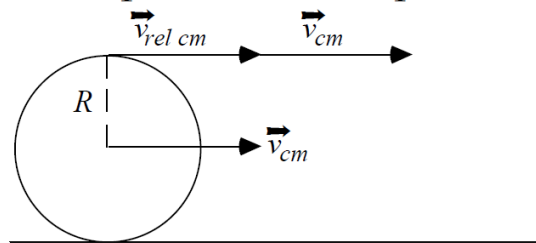
Now for a simple heuristic picture.

C, the speed of light, is the speed limit of the restricted and miniscule EM and color dimensions. The speed of the expansive 3-D “space” dimension for PLs , where the space warp of gravity is displayed and where the guide waves flow, is unlimited.

Now, since light is an EM phenomena, a rotating PLC Cluster when moving freely, it moves at the speed limit of that restricted dimension.

Matter, on the other hand, is a “looped” photon (e.g. electrons) or color photon (e.g. quarks). It is looped in our 3-D dimensions.

Consider the point on the top of the wheel:



Since light is still going at speed c at the top of the wheel, the speed of the loop, the relative speed of the “center of mass” (the particle) to the ground (the PL Mesh) is always less than the speed of light.

The kinetic energy can be written as a sum of translational and rotational kinetic energy: $K_{tot} = K_{trans\ cm} + K_{rot\ rel\ to\ cm} = \frac{1}{2} m v_{cm}^2 + \frac{1}{2} I_{cm} \omega^2$ where ω is the angular speed of the rotation relative to the center of mass and I_{cm} is the moment of inertia around an axis passing through the center of mass. The speed of the particle would depend on how it is “rolling” through the mesh. At best, it can only reach $\frac{1}{2} c$ if it only “rolls” through the mesh.

To get past that, it needs a lateral push by a PLC cluster moving forward along the mesh, pushing the looped photon with it. As the total kinetic energy increases, the energy of the PLC cluster pushing it is higher, which would quickly move it past the 16MeV limit we calculated for the oscillating photons, and it (photon length, loop circumference) becomes correspondingly shorter. This may visualize the “decreasing size” at higher energies (& Speeds- the Lorentz-Fitzgerald effect), due to the compression of the photon cluster. It may also explain why, as long as the “particle” loop configuration is maintained, the net speed of the particle will never reach the speed of light.

4.3 - TO BE CLEAR

“A compressible material substance permeates all space everywhere. A compressible material can move within, around, upon and through itself merely by deforming and changing the volume bits of it occupy during such motions.”

– Lebau, “In the beginning was God”

- There is an Ether: it is the mesh created by the PLs, Logical entities in the 3-dimensional world of their own making. On average, this mesh is “flat”, until distorted by “matter” (matter itself being the distortion of the Ether), and constitutes the background frame for reality.
- This Ether is Space. It is a relational space. Moving from one PL to an adjacent PL is moving in space.
- This Ether is also enmeshed in Time, creating a “Space-Time”. Time is the clicking of the PLs in and out of existence, a continuous process occurring at Planck time lengths.
- If a PLC clicks in place, at the same node, it experiences the passing of time. If it clicks into another node, it moves in Space, but does not experience time during that click. (It’s almost like the Universe can’t walk and check its watch at the same time ☺). This explains why Light, which moves in space continuously from one PL node to another, does not experience time, and also why the speed of light looks the same to all observers regardless of their speed, since in their motion they “lose” time clicks, which essentially lets them see light going at the same speed.
- Whiteheadviews change as the “Creative Advance” of the Universe - the sum of changes in space and in time of “events” composing the universe. This view spatializes time, and temporalizes space, creating a new constant metric for spacetime: Change, equal to change in space plus change in time. Since Change is related to action, and action is related to matter/energy, then this metric applies only to PLCs. It is the “Change Limit” speed of the Universe, equivalent to the c speed limit.
- This also explains time dilation at higher speeds. The PLC trades travel through space with travel through time. In high PL density regions, due to gravity’s warp, a PLC is more likely to experience other nodes, and hence slow down in time – hence GR’s time-dilation in Gravity fields. Once we have this “fixed” speed of light, the rest of Special Relativity rules apply. The resulting “space-time” mesh is Einstein’s absolute

Spacetime. This allows us to marry Einstein's and Lorentz views on spacetime, and the Lorenz-Fitzgerald effects.

- The warped gradient of space near a material body means an increase in the number of nodes/density, so a body moving towards it crosses more nodes/ more space for a given number of clicks, which is perceived as acceleration. This is Einstein's equivalence principle between gravitation and acceleration in action.
- PLs can go faster than light in the mesh, which is a logical Hilbert Space, by jumping nodes or other means, providing for the instantaneous, non-local character of Entanglement and wavefunctions.
- "Matter" is rotating photons riding the 3-D mesh, but their PLs are in separate dimensions of EM, color, etc. The PLs in those extra dimensions "project" on the 3-D space a warp, which we call Gravity. This projection is rather weak, relative to the strength of the PLs in their EM or Color dimensions, which explains the effective weakness of Gravity. Those collective effects on the metric show up as Gravity when averaged over macroscopic distances, whereas their high-energy, Planck-scale effects are non-relativistic, and quantum effects with discrete, unstable geometries reign in that region, violating Lorentz invariance.
- Matter also projects Pilot PLs in the 3-D dimensions, which act as Guide waves, a-la-Bohm-De Broglie, which explain the various effects of Quantum Mechanics.
- So the Ether is ALL there is. Tornadoes in that Ether look like particles; Atoms are rotating whirls of the PLs of the Ether. Photons are stabilized fluxes of this Ether. All of nature from one element ($E=mc^2$), with geometry and relationships doing the rest.
- As Wheeler had proposed: Logic \rightarrow Sets \rightarrow Topology (Pregeometry) \rightarrow Geometry \rightarrow Physics. Wheeler's idea for an idea, where simple quantum rules generate a pre-geometry out of the primordial logical bucket of dust, the set of logical yes/no propositions, with mathematics at the essence of the physical universe.

"I certainly feel that any idea that's reasonable lets itself be depicted in a picture that has some impact. If I can't make a picture, I feel there's something faulty about the idea or the thoroughness with which it's been investigated" – John Wheeler

4.4 - TO BE RELATIVELY CLEAR

To summarize the views on how our PL picture jives with Special and General Relativity:

A PLC Cluster (A Photon when propagating freely, matter when circulating), can move in one of two ways:

- It can move forward in the PL mesh, effectively moving through “Space”. When the Cluster clicks from one node to another, it has moved through Space, but time has not moved for it.
- It can also click “in-place”, at the same Node. In this case, it is not moving in Space, but instead is moving in Time.
- Since the PLC is clicking at a “constant” rate, and has to choose one of the two options above (moving in Space or Time), then its net motion in both Space and Time is constant. Translated to SR, its motion in Minkowski Space-Time is at a constant rate, basically the “invariant” speed of Light, “c”.

The above applies to the PLCs, which are the PL clusters that live in the EM & Color dimensions, which form Photons and Matter. Photons, who constantly move forward in Space, do not feel time. Matter, which tend to circulate in place, move mostly in Time, and when they move in Space, their time slows down.

From here, the effects of SR take over.

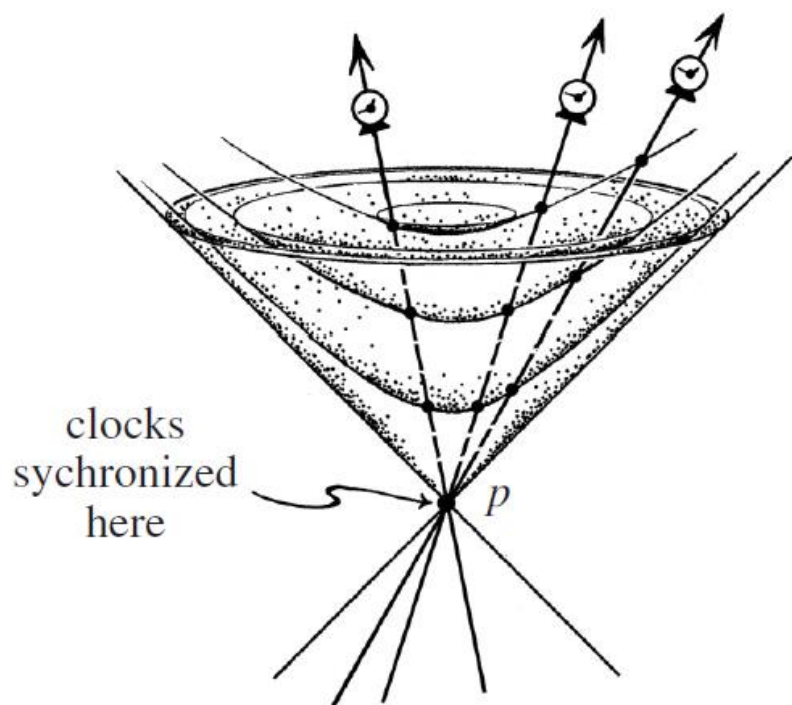
The Pls that are in the 3-D space itself – the Pilot waves and the Gravitational Metric, are not so restricted. Their motion in that 3-D space, while being a reflection of the PLC motions in the EM and Color dimensions, are not restricted to the Speed of Light, and can impart their effects almost instantaneously, providing the non-Local features of the Universe and the various Entanglement effects.

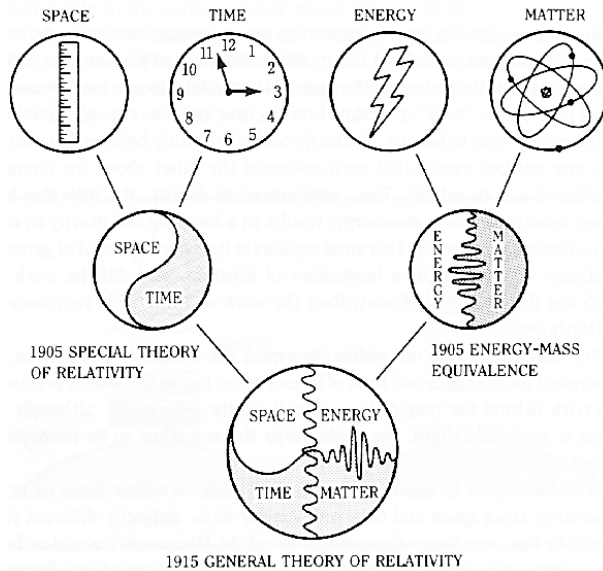
For GR, the “density” fluctuations in the PL Mesh correspond to its Energy, Mass, and the Gravitational potential they emulate. An equi-density area of the Mesh is an equi-potential area in the Gravitational field. The “gravitational” compression of the mesh is an expression of the higher density of PLs in that area of the Mesh. The Ether, the light-carrying medium, the mesh, is

compressed by the presence of PL Clusters, and imparts the effects of “Gravity” as a result.

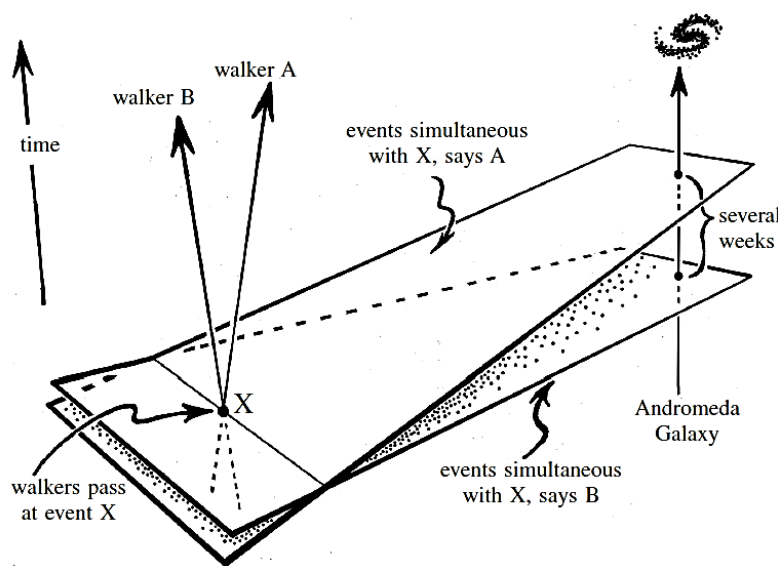
A superluminal gravity impact means we have a basis for simultaneity in the gravitational field and metric, but one that does not allow for the transmission of messages, since those are transmitted via light and matter, which still obey the “c” speed limit. The structure of Special & General Relativity is thus an “overlay” over the basic mesh structure, resulting from our own conception of space and time as “energetic” event relations. Each point in general relativity has its own time clock, impacted by the “density” of PLs in the background mesh. Similarly, each observer in Special Relativity has his own clock that moves as a function of his speed. Simultaneity for him is defined in relationship to what he “sees” via the light rays. Even his rulers seem to be affected by this view, even though their actual size does not physically change.

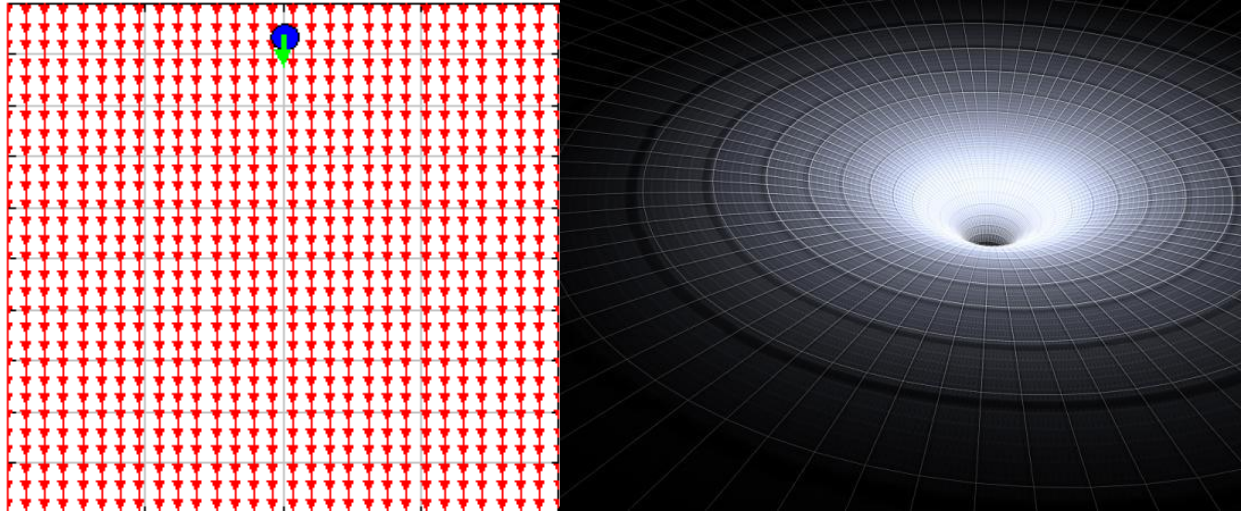
One way to see the time dilation effects is also as a “density” aspect of time, related to the PL density. A moving observer clicks through many PLs, with that clicking not counting as time. Since all motion is relative, we can see this as the observer being in a “high time density” zone when moving, slowing down his time, the same way matter moving in a high PL density (gravitational field) zone is seen to “slow down”, effectively making it look like time slows down.





The gravitational field presents the simultaneity frame for Pls. The Light (EM) field presents the simultaneity frame for PLCs. As Penrose suggests, “rest-mass” is necessary to build clocks, and therefore a different definition of time is necessary for those particles with mass than for the vacuum. The same applies for photons, for although we use their frequency to measure time, they themselves do not feel time, and matter is still necessary to construct the clocks (and our minds!) to make the concept relevant. As Penrose suggests, “our normal macroscopic picture of space-time arises only as a useful notion derived from a more primitive geometric structure (as happens with ‘Machian’ theories or with twistor theory).”





PL Simultaneity

Einstein had anticipated this: “There may be supposed to be extended physical objects to which the idea of motion cannot be applied. They may not be thought of as consisting of particles which allow themselves to be separately tracked through time. In Minkowski’s idiom this is expressed as follows: - Not every extended conformation in the four-dimensional world can be regarded as composed of world-threads. The special theory of relativity forbids us to assume the ether to consist of particles observable through time, but the hypothesis of ether in itself is not in conflict with the special theory of relativity. Only we must be on our guard against ascribing a state of motion to the ether”.

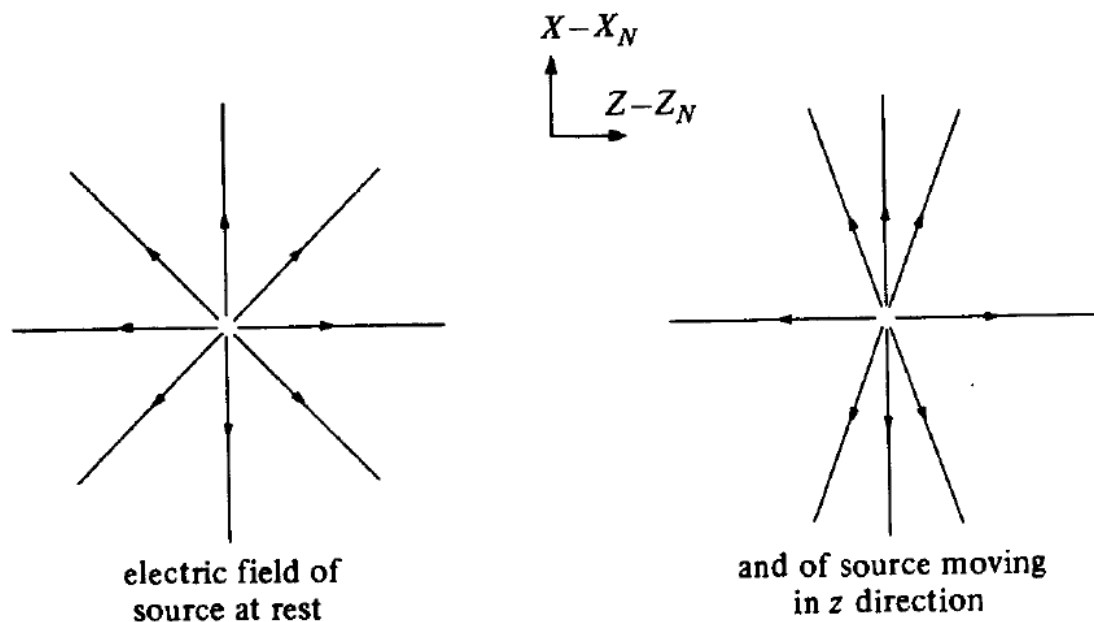
The continuity between Lorenzian Relativity and Einsteinian relativity is best explained by John Bell’s gem – “How to Teach Special Relativity”, that shows the disconnect to be a philosophical approach, while the physics below remains the same. The Poincare invariance of the laws of physics (such as Maxwell’s equations) is equivalent to Einstein’s frame-changing analysis.

Starting with the Larmor-Lorentz-Poincare approach, which looks at matter systems as arising wholly from electrodynamically interacting components (electrons, protons, etc), one can show that classical Maxwell equations lead to uniform contractions of the system in the direction of motion (Heaviside-Ellipsoid), as well as changes in “orbital timing” (aka Time) consistent with Lorenzian transformations and Special Relativity. Larmor had shown this in 1900 (using an analogy with the motion of vortex lines in hydrodynamics), ahead of Lorentz and Einstein. “In so far as microscopic electrical forces are important in the structure of matter, this systematic distortion of the field of fast particles will alter the internal equilibrium of fast moving material. It is to

be expected therefore that a body set in rapid motion will change shape” (Bell), as proposed by Fitzgerald in 1899. The similar Time dilation factor

$$\gamma(v) \equiv \frac{1}{\sqrt{1 - v^2/c^2}}$$

was also proposed by Larmor. Lorenz had also shown the electromagnetic mass rises with velocity, before the theory of relativity. In fact, the “Twins Paradox” was presented in 1911 as “Le Voyageur de Langevin” with both views in mind.



The beauty of this “physical” explanation by Lorenz & Larmor is that if you change the variables in the Maxwell & Lorentz equations to correspond to the new frame, they “have exactly the same form as before” (Bell). That is their Lorenz invariance! The equations demonstrate the “relativity” of motion, in detail. “...*the expression of the field of the uniformly moving charge in terms of the primed variables is identical with the expression of the field of the stationary charge in terms of the original variables*” (Bell; emphasis his). The translation needed is the Lorenz transformation. The view is entirely relative, as in Einstein’s scheme, down to the effect of retinal contraction, etc., etc. What Lorenz, Larmor and Poincare did was to look at the physical laws, and investigated what happens to those laws for a moving observer. They found that, with the proper coordinate transformation, nothing is changed. Larmor calculated how “individual electrons describe corresponding parts of their orbits in times shorter for the [ether] system in the ratio ...” while Lorentz noted for the frequency of oscillating electrons “that is S the time of vibrations be k_E times as great as in S_0 ”. It all fit together. Poincare’s

(often contested by some as the true founder of the principle of relativity, especially since he coined the term) “New Mechanics” supplied a good part of Einstein and Minkowski’s Special Relativity.

Einstein, on the other hand, started from the other end. He *assumed* “the hypothesis that the laws will look the same to all observers in uniform motion” (Bell), and went on to build a cool geometric view of how this explains contraction, dilation, and the various features of special relativity. His results match Lorenz’s identically. The difference is a matter of style and philosophy, as Bell says, with the same underlying physics. Even today, people still confuse the two theories as inconsistent, and any detailed analysis “can (I fear) set off premature philosophizing about space and time” (Bell) ☺. When Varicak asserted that length contraction is “real” according to Lorenz, while it is “apparent or subjective” according to Einstein, Einstein himself felt obliged to reply: “The author unjustifiably stated a difference of Lorenz’s view and that of mine *concerning the physical* facts. The question as to whether length contraction *really* exists or not is misleading. It doesn’t “really” exist, in so far as it doesn’t exist for a comoving observer; though it “really” exists, i.e. in such a way that it could be demonstrated in principle by physical means by a non-comoving observer”. The math works, as does the physics, but one has to be careful with the interpretations. For example, Penrose and Terrell showed that moving objects do not appear contracted on a photograph – the contraction is relevant only for measurements at the exact locations of the object’s endpoints. A photo of a moving sphere would show it still circular, but rotated! (Penrose-Terrell rotation).

Mermin reminds us that our laws of modern physics were “built” with SR in mind- “relativistic quantum mechanics” ensures that when you apply its rules to calculating the rate of a moving clock, you get the time dilation. Using Dirac’s equation to calculate the vibration rate of an atom shows the rate of vibration changing according to the slowing down factor of SR. It is not a circular trap, but rather a relational point of view. “Moving clocks really do run slow and moving sticks really do shrink, if the concept of the rate of a clock or the length of stick is to have any meaning at all”. As Lorenz had assumed, “within any given frame of reference the physical laws that govern the lengths of sticks and the rates of clocks provide complete and compelling explanations of why a stick must shrink when set into motion along the direction of its length, and why the rate of a clock must diminish when it is set into motion. People who hedge their words with “appear to” have not adequately grasped this fact” (Mermin). The rope between two rockets going to an equal uniform speed DOES snap - meeting Dr Johnson’s criteria for reality. What confuses us is that there are so many ways of describing

the effect (Einstein's geometric view, Lorenz's "physical" view, etc.). "Much of what we used to think was inherent in the phenomena turns out to be merely a manifestation of how we choose to talk about them." Oh-oh, do I hear Bohr laughing from above?

The effects of Special Relativity (SR) and Lorenzian Relativity (LR) demonstrate the applications of specific trigonometric transformations, including Poincare & Lorenz transformations on Minkowski Space-time. It is all driven by the shape of spacetime described by Minkowski, and a PL Fluid Universe that meets that criteria will support SR as well as LR. The Preferred frame of the dynamic new Ether does not conflict with either theory. Because the same mathematical formalism occurs in both, it is not possible to distinguish between them by experiment. "The main difference was the metaphysical postulate of a unique absolute rest frame, which was empirically undetectable and played no role in the physical predictions of the theory". While an ether is acceptable (indeed, required, as Einstein later admitted), it is to be preferred among all frames of reference, and clocks in this frame show "real" time and simultaneity – but since it complies with relativity, it is impossible to find it. Herbert Ives's attacks on SR as "ununderstandable" and "untenable" are clearly "unwarranted". However, his confirmation (with Stilwell) of time dilation shall wipe that mark ☺.

"We had adopted a convention because it seemed convenient and we had said nothing could constrain us to abandon it. Today some physicists want to adopt a new convention. It is not that they are constrained to do so: they consider this new convention more convenient: that is all. And those who are not of this opinion can legitimately retain the old one in order not to disturb their old habits. I believe, just between us, that this is what they shall do for a long time to come." – Poincare

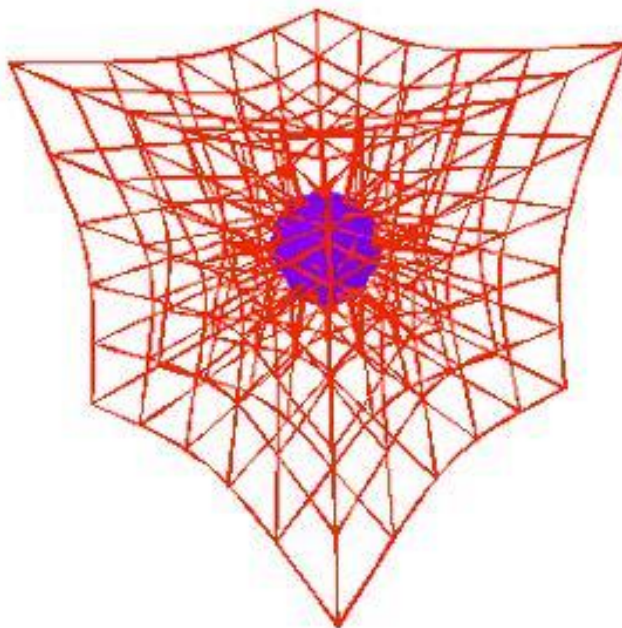
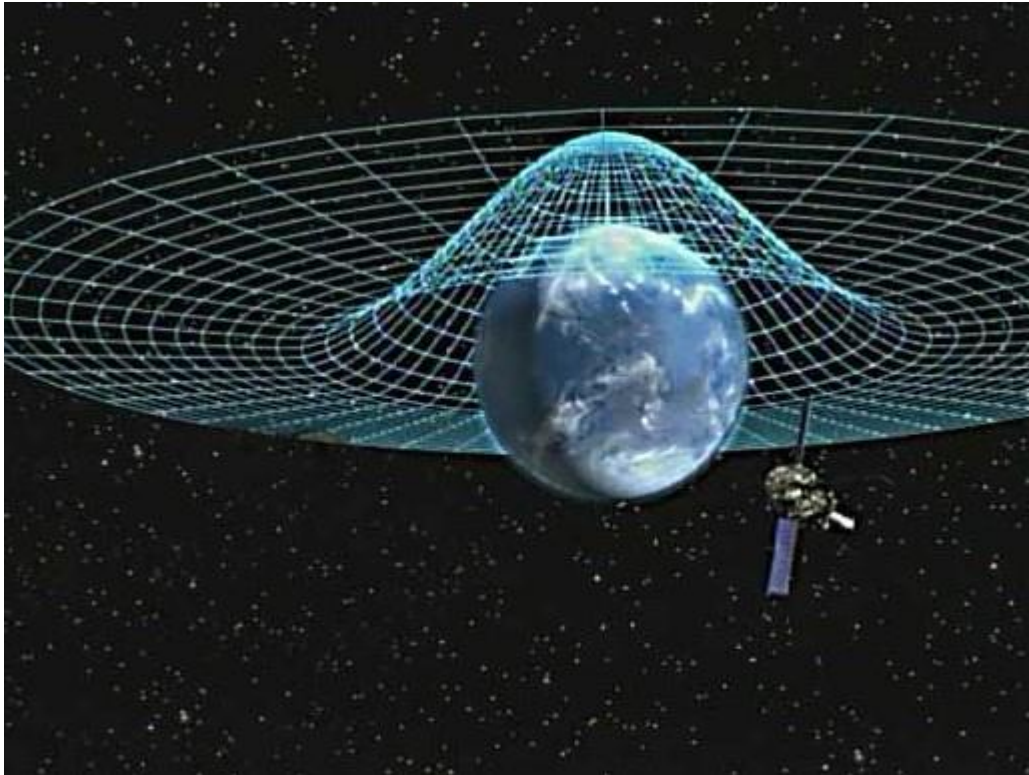
"... I am unable to prove, or even formulate clearly, the proposition that a sharp formulation of quantum field theory... must disrespect serious Lorentz invariance. But it seems to me this is probably so." – John Bell

"For bulk matter, including living things, time is an illusion involving the laws of chance as applied to large numbers of atoms". - Frank Close

"It may be that causal influences do go faster than light. The role of Lorentz invariance in the completed theory would then be very problematic. An 'aether' would be the cheapest solution ... But the unobservability of this Aether would be disturbing. So would the impossibility of 'messages' faster than light, which follows from ordinary relativistic quantum mechanics in so far as it is unambiguous and adequate for procedures we can actually perform. The exact elucidation of concepts like 'message' and 'we', would be a formidable challenge."
– John Bell

4.5 - TWO VIEWS, SAME SCENE

The marriage of Relativity and our PL Ether provides multiple windows on Reality – Many views of the same Scene, with the Math being identical in most cases, when interpreted properly.



This three-dimensional grid gives a better idea of what curved space-time might look like than the two-dimensional analogies do.

The two dimensional picture above views the effect of mass-energy on space as a “warping effect” of a space sheet, with the “amplitude of the field” reflecting the departure from our Euclidean Space.

The next picture shows a 3-D perspective, where the effect is shown as a Node density effect, where the PL nodes are clustered more closely due to the same warp, and hence Space is deformed.

The two pictures are just ways of “visualizing” the same scene.

To view the effects of General Relativity on time, we can:

- look at the 3-D “density” picture:
 - A Photon going through the denser matrix has to cross more nodes in space. While it clicks through those nodes at a “constant” rate, and therefore crosses the same number of nodes per second, looked at from the mesh point of view, it would have crossed a smaller portion of the Hilbert Space (from an ‘outside Euclidean observer” view), looking like it has crossed a smaller distance. That is how Light “slows down” in a gravitational field, and how time dilation is produced.
- Look at the 2-D picture:
 - A photon going through the warp has to take the “geodesic” straight line, which, relative to the Euclidean line, looks like the long way, warped around the hump. For our Euclidean eyes, it seems to be taking longer to cross the same “distance”.

To view the effects of General Relativity on “acceleration”, we can:

- look at the 2-D picture:
 - Light follows a “straight” path in the Mesh. Given the warped shape of the space, this “straight” path translates into a geodesic, which, when mapped on an Euclidean space picture in our minds, looks curved. The Light “looks” to us like it is following a curved path in Euclidean Space, which is how we visualize space. This “curving” of the Light Path we interpret as a “force” effect causing acceleration. The same goes for particles.
- Look at the 3-D picture:
 - The reduced speed of Light in the “dense” mesh produces a “Refraction” effect, as it does when Light impinges on water

(Eddington's original picture of Gravity's effect), with the Fresnel Drag simulating the effects of Gravity.

Einstein himself had seen this dual view: "... Maxwell's equations may be written as if they were valid in a flat space-time in which there is an optical medium... this medium turns out to be equivalent to the gravitational field. ... we find that the language of classical optics for the "equivalent medium" is as suitable as that of Riemannian geometry." The varying velocity of light in media explains the relativistic effects, as well as the gravitational effects. As Eddington said in 1921: "Light moves more slowly in the material medium than in a vacuum, the velocity being inversely proportional to the refractive index of the medium. The phenomenon of refraction is in fact caused by a slowing of the wave-front in passing into a region of smaller velocity. We can thus imitate the gravitational effect on light precisely, if we imagine the space around the Sun filled with a refractive medium which gives the appropriate velocity of light."

In standard GR, the Einstein curvature tensor is interpreted as the curvature of space-time. In Eddington's view, it is interpreted as the density of a medium (the Ether) varying in the Sun's gravitational field. Hamilton had done this earlier when he showed that Newton's laws of mechanics could be re-written in a form that makes them look like the laws of optics. Both Mathematical formalism lead to identical results, with the correct bending of Light predicted. Similarly for the time dilation effect. Two views to the same Scene.

Nature affords us many opportunities for a Dual view of its Code. A Gamma photon can be seen as splitting into a positron and an electron. OR it can be seen as the Gamma photon knocking out an electron out of the Dirac Sea, leaving a hole behind (a positron).

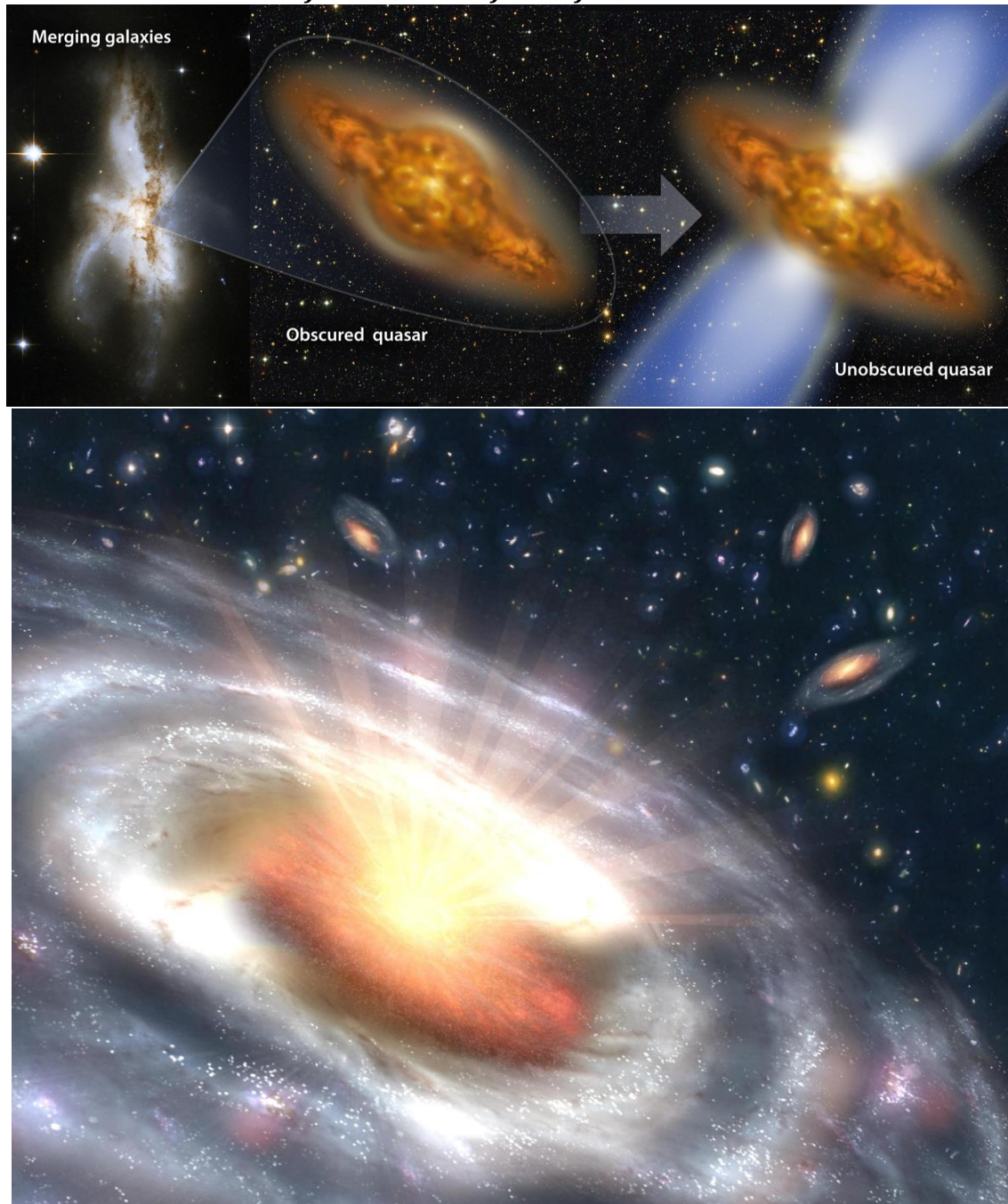
"A field of force represents a discrepancy between the natural geometry of a co-ordinate system and the abstract geometry arbitrarily ascribed to it."

- Arthur Eddington

5 - THE SHINING UNIVERSE

“In Modern Physics, there’s only one thing, and it’s more like the traditional idea of Light than the traditional Idea of Matter.” - Frank Wilczek

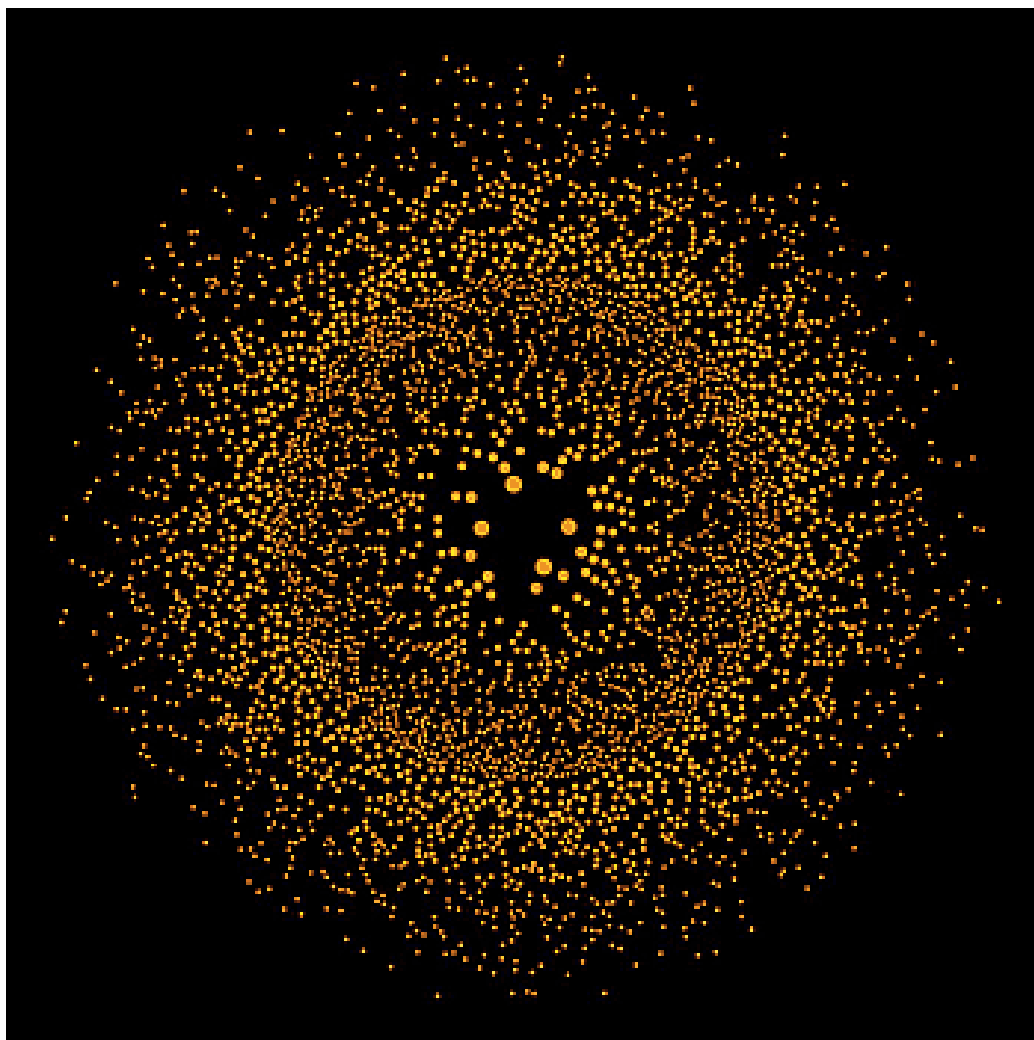
“Energy has all the right properties to be considered a kind of fundamental substance of the universe: it is indestructible, it enters into all dynamical processes, and matter itself is a localized form of it”. - F. Selleri



5.1 - PHOTONS

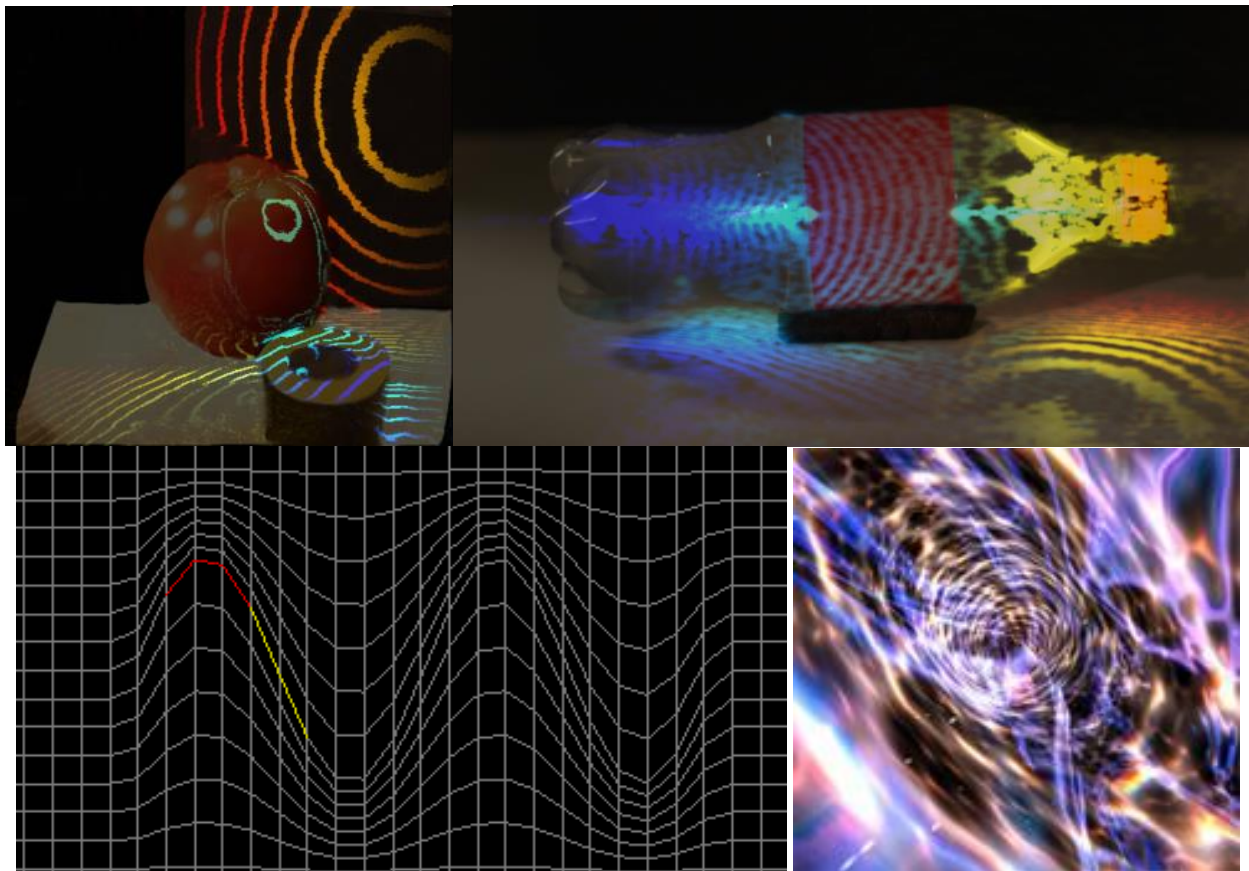
Our key player here deserves some attention. Even though the PL is the basic component, in the Vacuum it is uniformly and thinly distributed (one per node in the Universal Vacuum), so its effect is limited to space creation at a slow rate.

The main action comes from Photons, those thick PL clusters travelling at the speed of the mesh, c , carrying “existence” energy. “Discovered” (as a particle) by Einstein, it got christened “Photon” much later by Lewis, when doubt of its existence was overcome. Many experiments, the Compton effect, and anti-bunching experiments verify its particle-like nature, while others (Young’s, variations of Slit experiments) display its wave-like nature. QED sees it as a “Field-Quanta” of the pervasive Electro-magnetic field. Here, a “PLC Packet” picture affords a way to merge these views.



Traveling at the speed of light (itself ☺), relativity endows it with immortality and omnipresence. From a photon's point of view, it is emitted and then instantaneously reabsorbed. This is true for a photon emitted in the core of the Sun, which might be reabsorbed after crossing a fraction of a millimetre's distance. And it is equally true for a photon that, from our point of view, has travelled for over 13 billion years after being emitted from the surface of one of the universe's first stars.

So it seems that not only does a photon not experience the passage of time, it does not experience the passage of distance either. Because the photon is moving at the speed of light, the entire path from emission to destruction has zero length and zero time passage. Time and space are both warped while it is in flight. It does not matter what we measure or calculate. The entire experimental assembly we put in place to study Photon phenomena is to the photon like a flat surface with all the options congruent to the front surface, that surface being stuck to the point of its emission, and shrunk to zero thickness, glass, air paths, mirrors and all. All the open paths are the same length (zero) to the photon, regardless of how we measure them.



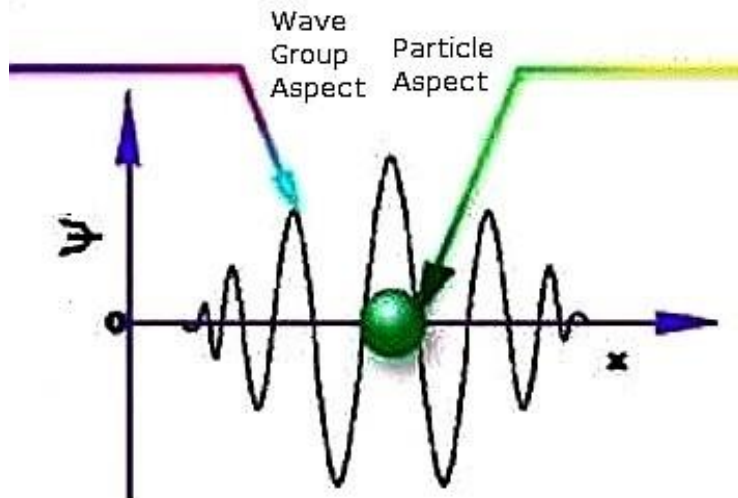
The speed of light is the speed limit in our 3D+1 Spacetime, the speed of spacetime ripples (including gravitational waves and gravitons). The Photon has been ascertained to be “massless” (in the sense of rest mass) to a high degree of accuracy.

In QM, the Photon wavefunction is difficult to formulate – perhaps because light itself is a wave, and defines time as well. Maxwell’s equations for EM waves and Schroedinger’s equation for Photons are not alike, and the Heisenberg uncertainty principle $dx*dp > h/2$ does not apply. Photons cannot be localized without being destroyed – a photon is committed to move and spin at light speed. In Pilot wave approaches, we have to look at the Pilot wave as a simple extension of the Photon itself, with the same frequency, thus explaining the particle/wave duality of its nature.

One clue to the unitarity of nature, and the common origin and content of photons and matter: Vector Meson Dominance (VMD) theory, designed to explain why photon interactions with charged protons and neutral neutrons are similar, suggests the photon is a superposition of the pure electromagnetic photon and vector mesons. When experimentally probed at very short distances, the intrinsic structure of the photon is recognized as a flux of quark and gluon components, quasi free according to asymptotic freedom in QCD and described by the photon structure function. Our suggestion that all of this is made of PLs in different dimensions is strongly implied – it is only structure and geometric configurations that give the various observed aspects, while the unity underneath is preserved.

Light travels at a lower speed in matter than in vacuum. Many alternative ways to explain this exist, but I recommend the view that in matter clusters, the “bunching” effect of mass warping the space increases the number of nodes being crossed in that space, hence slowing down the light which hops those nodes.

Photonic molecules have been formed in cooled vacuum chambers– Photons interacting so strongly that they act like they have mass, an effect analogous to refraction. They enter as light, behave like coupled light and matter inside, but exit as light. In other experiments, micrometer sized cavities can trap photons inside, making them look like electrons in an atom (strengthening our proposal that the electron is a trapped circulating photon). These trapped photons can be made to interact, creating photonic molecules, whose optical modes closely resemble those of a diatomic molecule like Hydrogen.



Euler and Kockel had shown from light-scattering experiments that the “cross-section” of visible light is of the order of 10^{-70} cm^2 , basically the planck length/area range. This means the photon PLCs travel a path one node wide only in our emanent 3D space. This confirms our view that a photon looks like a **travelling line wave/point in the 3-D world**, while its main energy circulates in the extra EM dimension. Basically the photon looks like a traveling string, vibrating in the EM dimension, but essentially traveling like a straight arrow in 3D space. (Conversely, electrons, being looped photons in the 3-D space, have a larger cross section corresponding to the circle formed by their loop).

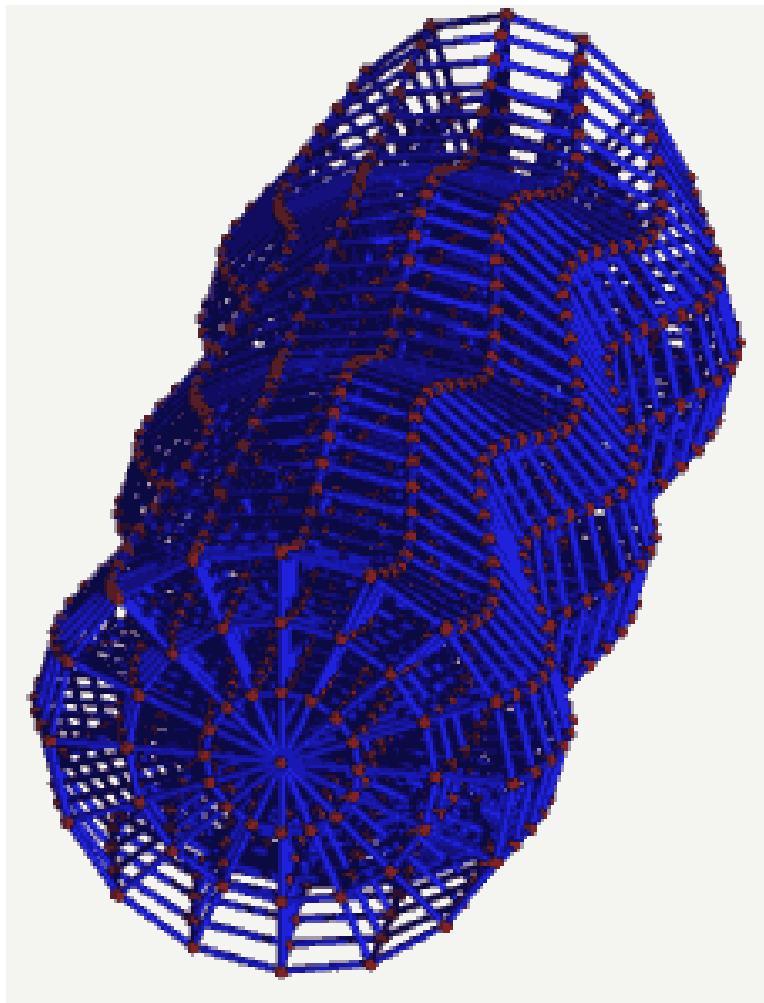
The reality of the photon wave coinciding with the photon wave function leads to an almost classical behavior, so much so that Ed Jaynes could formulate a neo-classical radiation theory (NCT) in the 70's, that could describe almost all EM phenomena without recourse to QED. It assumed Schroedinger's equation governing the wave function, the square of this function providing a physically real electric charge density, and Maxwell's equations describing real EM radiation fields. This approach could explain the absorption of radiation, spontaneous and stimulated emission of radiation, the Lamb shift and the black body radiation spectrum. While EPR type experiments demonstrate a failure of this model, that is a limited scope of applicability that is explainable by our Patchwork- Space model described below.

Chew notes that in quantum field theory, the various fields are introduced as operators that do not correspond to observables, EXCEPT for the electromagnetic field! The photon's zero mass allows the electromagnetic field

to have the status of a classical observable, and cannot be described by the S-Matrix. In our PL picture, the S-Matrix describes the interactions of particles, but the photon is the basic building block of those particles. He concludes that “Electromagnetism is deeply mysterious and its origin unlikely to be explained within our current scientific framework because the unique attributes of this interaction are inextricably enmeshed with the framework itself”. He associates the photons with the idea of “gentle events” of graph theory, which “pile up coherently, and those coherent superpositions of photons generate the classical fields”, and in consequence space-time.

Those photons, swimming in Poincare’s “fluide fictive”, remain a mystery in constant motion, the Buddhist Samsara.

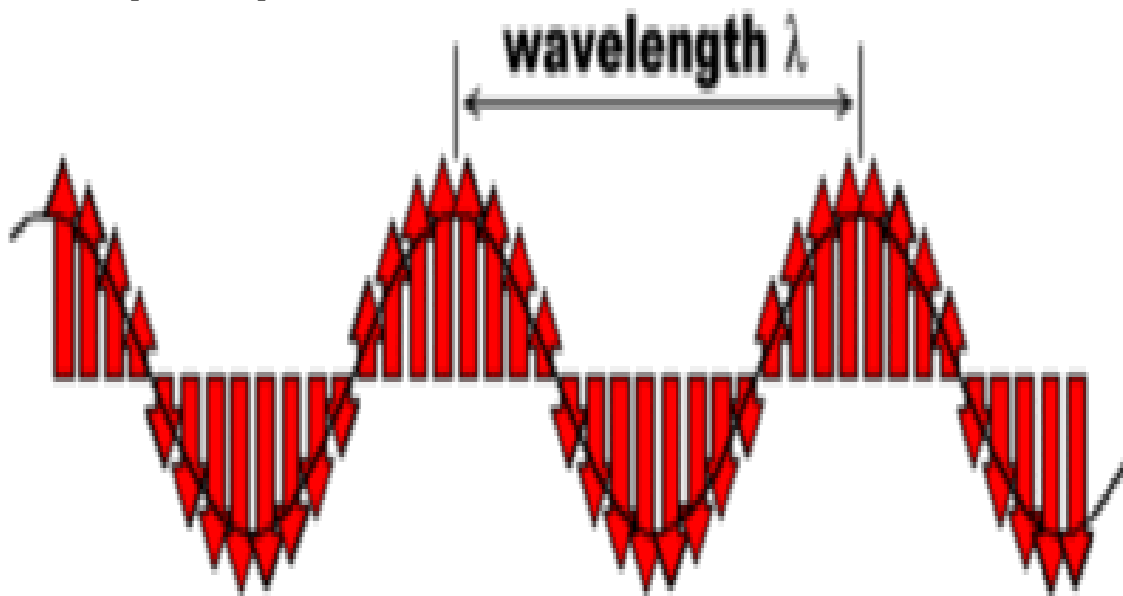
“Those photons sure don’t have a holding-pattern” – Tom Phipps



“When we come to light, we are coming to the fundamental activity in which existence has its ground.” – David Bohm

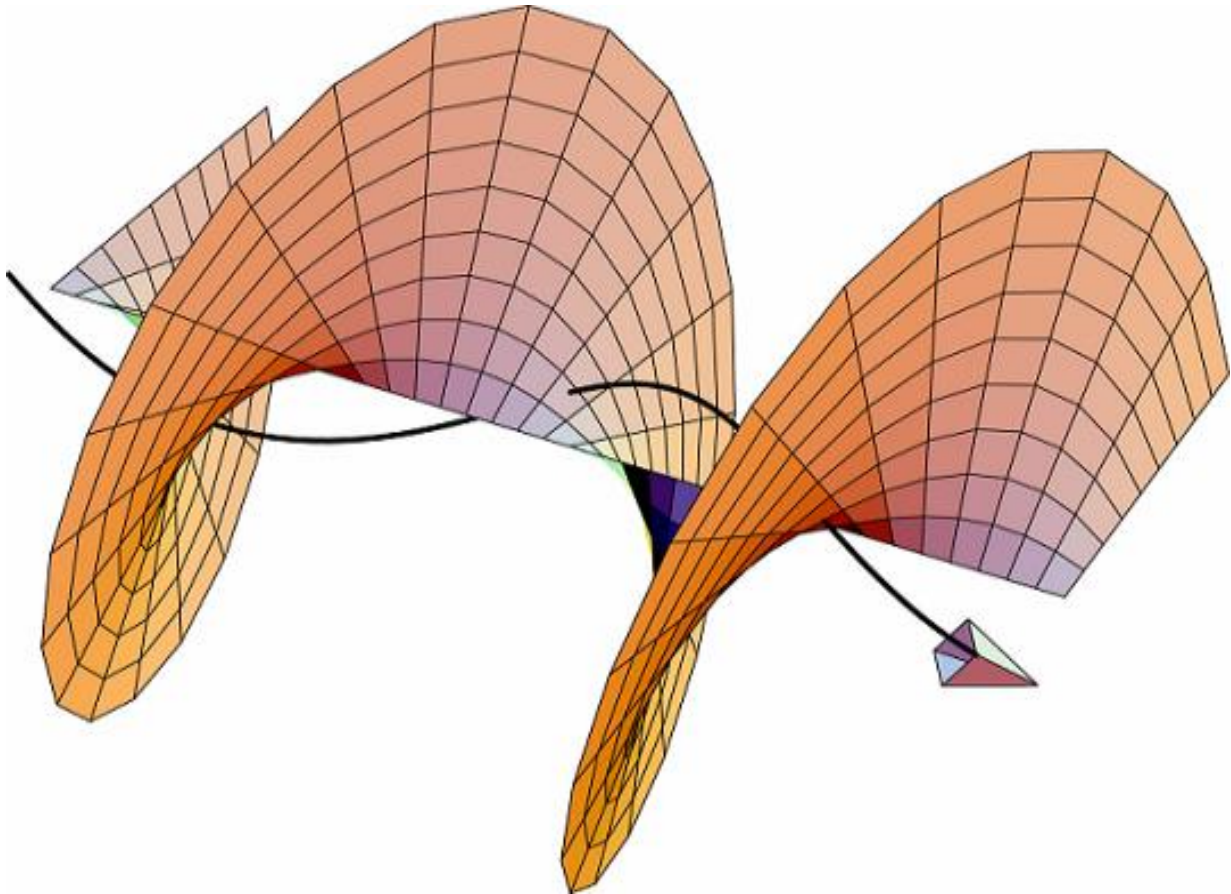
5.2 - TRAVELING CLUSTERS

- The traveling PLC packets click through the space fabric sequentially, their density varying in “time” (each click). The Higher the energy, the higher the “urge” to return to nothingness, the “faster” (read the less number of clicks) the modulation of the packet density (change in number of PLs “existing” at the subsequent node), the faster the perceived “Frequency” of the photon bundle (compare the quantum notion of “borrowed” energy having to return to the vacuum in $t=h/E$). Field theory sees the photon destroyed at each point to be recreated at the next point, a parallel to our PL dive into Netherworld.



- The Speed of this cluster is “c”, by definition the speed of light. It comes out NATURALLY from Maxwell’s field equations! Super-symmetry itself enforces motion on light – Light CANNOT stop. It also requires it to rotate as it moves. Spin and motion are not optional for a Photon.
- The flow of PLs between the two E & M dimensions provides a Helical screw view, where a “flat” plate of PLs moves forward while rotating between the two dimensions.
- With $E=h\nu=hc/lw=h/tw$, you see $E*tw=h$, a constant. A minimal uncertainty in lw of a planck distance lpl (the minimal quanta of distance), results in an minimal uncertainty of c/lpl in the tw , and a corresponding minimal uncertainty in the energy. Since tw is the range of uncertainty on photon timing (one wavelength), then the $dE*dt=h$ relationship arises naturally. Similarly for momentum p , $E=pc=hc/lw$,

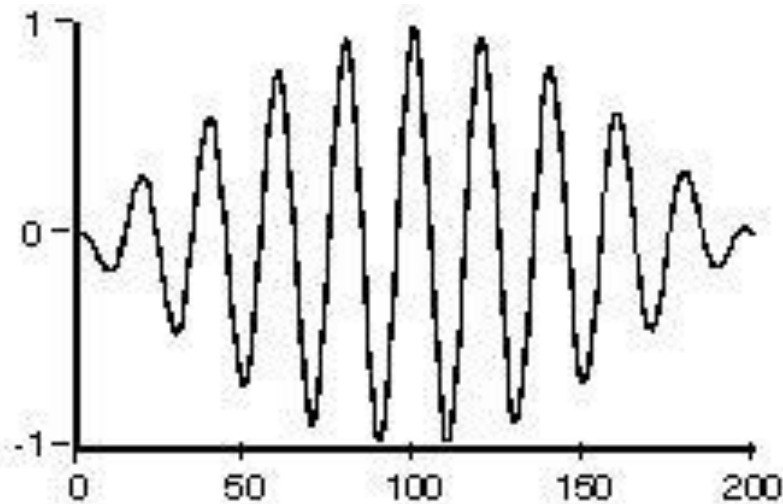
we get $p \cdot l_w = h$, and with l_w the minimal uncertainty on position, we get $dp \cdot dl = h$, the position-momentum uncertainty relationship.



- The speed of motion of the PLs in the two extra dimensions (or one circular dimension) is not limited by the speed of light, but results in a speed c for the full forward motion in the 3-dimensional space, where we see it as the speed limit. Each full rotation of the disk represents a wave of the light in the 3-dimensional space.
- We can see the photon as a moving disturbance in the electric and magnetic field space. The length and height of this disturbance is related to the “Energy” pressure carried by the light, a function of a characteristic “elasticity” of the medium. This disturbance, “warp” caused by the photon, contributes directly to a strong EM field effect, and more weakly to a gravitational metric effect. The effects are similar, with the EM fields bending the trajectories of charged bodies, while the Gravitational metric field bends the trajectory of bodies with energy and mass (as would color gluon fields bend bodies with color charge, like quarks). The unity of nature displayed in the fields of space.

5.2.1 - THE MEASURE OF LIGHT

- The length and “time” (duration) of a photon is related to its emission time. In describing the emission in a transition between the 2S and 1S orbitals of an electron, Henderson et al. describe the oscillations in charge density between the two orbitals at the Bohr frequency. This periodic fluctuation is called “transient nutation”. The number of cycles from start to finish is between 10^6 and 10^7 . The oscillations begin small, are strongest in the middle, and then die off, as shown below:



- The above process is not abrupt, but a continuous process that takes time, creating the Photon “wave” packet. They also noted that a **shorter mean wavelength of the emission implies a shorter radiative lifetime**, representing the higher PL pressure of a higher PL density in our model. The radiative time is approximated by the relationship:

$$\tau_{\text{rad,ceo}}(\text{ns}) \approx \frac{45 \times [\lambda_0(\text{microns})]^2}{n},$$

where n is the refractive index of the medium. Thus the T_{ph} of a photon is proportional to the square of the wavelength. Since L_{ph} of a photon is equivalent to $N \cdot l_w$ (N being the number of “waves” or

cycles in a packet), and lw is proportional to c/v (v being the frequency), then $L_{ph} = N \cdot c/v = c \cdot T_{ph}$; $T_{ph} = N/v = N \cdot lw/c = k \cdot lw^2$; This gives us:

$$N = k \cdot c \cdot lw = k' / v,$$

which gives us a way to calculate the length of a photon packet and its duration, which are inversely proportional to the frequency squared. A High frequency wave is very short and very quick, making it look like a point particle emitted/absorbed instantaneously.

Sample data:

Wavelength (m)	radiative lifetime(s)	Photon Length (m)	Photon Energy		spectrum
9.93609E-07	4.44267E-08	1.33E+01	0.001	KeV	IR
4.96805E-07	1.11067E-08	3.33E+00	0.002	KeV	VIS
2.48402E-07	2.77667E-09	8.33E-01	0.005	KeV	UV
1.24201E-07	6.94167E-10	2.08E-01	0.01	KeV	UV
6.21006E-08	1.73542E-10	5.21E-02	0.02	KeV	UV
3.10503E-08	4.33854E-11	1.30E-02	0.04	KeV	UV
1.55251E-08	1.08464E-11	3.25E-03	0.08	KeV	UV
7.76257E-09	2.71159E-12	8.13E-04	0.2	KeV	UV
3.88129E-09	6.77897E-13	2.03E-04	0.3	KeV	UV
1.94064E-09	1.69474E-13	5.08E-05	0.6	KeV	x-ray soft
9.70322E-10	4.23686E-14	1.27E-05	1.3	KeV	x-ray soft
4.85161E-10	1.05921E-14	3.18E-06	2.6	KeV	x-ray soft
2.4258E-10	2.64804E-15	7.94E-07	5.1	KeV	x-ray soft
1.2129E-10	6.62009E-16	1.99E-07	10.2	KeV	x-ray hard
6.06451E-11	1.65502E-16	4.97E-08	20.5	KeV	x-ray hard
3.03226E-11	4.13756E-17	1.24E-08	40.9	KeV	x-ray hard
1.51613E-11	1.03439E-17	3.10E-09	81.9	KeV	x-ray hard
7.58064E-12	2.58597E-18	7.76E-10	163.8	KeV	x-ray hard
3.79032E-12	6.46493E-19	1.94E-10	327.6	KeV	x-ray hard
1.89516E-12	1.61623E-19	4.85E-11	655.1	KeV	x-ray hard

- The above poses an interesting challenge to the wave-particle duality concept, and the experiments used to verify it. Those who see light as a “particle” would have trouble verifying this when the wavelength above exceeds the experimental apparatus used – an IR wave of 130 meters would be all over the place in a desktop

experiment, reflecting many times before the “photon” ends. It would be interesting to analyze the mix of issues resulting for the various types of waves in experiments, and how that affects phenomena like superposition and interference at those scales. On larger scales, both multi-photon-ensemble-waves interpretations and single photon waves can be used to approximate classical results, but the smaller experiments would need to investigate the effects of larger wavelengths more carefully.

- So the energy per wavelength of a photon is $E/N = hv/N = h \cdot c / \lambda \cdot N$ or $E/N = h / \lambda \cdot c \cdot N = hv^2 / \lambda \cdot c^2$. The **“Energy” carried by a single wavelength is inversely proportional to the square of the wavelength, and proportional to the frequency squared.**
- This is a satisfying and expected result. For the PLs in the photon disk to go around the disk while moving forward at the speed of light, they would be delivering that energy E/N . If we take the “Pressure” as equivalent to the Energy, then we can expect the “radius” of the moving PL disk to be proportional to the Energy level, an “elasticity” aspect of the space of the EM dimension (here taken as a circular dimension, or two short dimensions where the PLs rotate). So if the radius is proportional to E , the area of the radius, which corresponds to the number of PLs in it (its energy/wavelength), would increase as the square of E .
- So the number of PLs PER wave-length/oscillation is proportional to E^2 , and every swing of the electromagnetic field delivers that nugget of PLs. $E = hv$ means as frequency doubles (number of swings per time), the Energy doubles, while the number of “waves” in the photon goes by half! So each swing delivers an amount of PLs proportional to the total Energy squared– a Universal stretching effect of the E&M dimensions. When a high Energy source has to deliver a lot of energy, it has to go through many oscillations of the electric/magnetic fields (which are synchronized and orthogonal) to deliver the energy in the number of nuggets needed. The Basic quantum of EM Energy is then this nugget of “Energy” (number of PLs) that passes in a single wave.
- So let us try this thought experiment: Since the energy per cycle increases as the square of the frequency, while the Energy itself

increases linearly with the frequency, then there should be a frequency (i.e. Energy level) at which the total energy will fit in just one cycle. At that point, we would expect something else to happen- the normal sinusoidal cycle no longer fits, and perhaps the “stretching” of the EM dimension stops, and we start getting non-linear effects, etc, that may be where new things start to happen with the other dimensional forces and new geometries start to be preferred – like trapped resonances (matter, like, say, electrons).

- A first cut at calculating this Energy from the data above:

Wavelength (m)	radiative lifetime(s)	Photon Length (m)	Photon Energy	spectrum
1.89516E-12	1.61623E-19	4.85E-11	655.1 KeV	x-ray hard

At this energy, photon length is about 25 “cycles” long only. Since the photon time (and hence length) decreases by the square of the wavelength, if we decrease the wavelength by a factor of 5, we decrease the length of the photon by a factor of 25. Lph is then 5 lw. Another factor of 5, and photon length equals the wavelength! So this will happen at a **photon length of about 7.6E-14 m, and a wavelength of 7.6E-14m**. This is the Gamma Ray range, the highest frequency we normally can see/create. This happens at energies of around 16 Mev. At this energy, we are only a few multiples of Electron energy (0.5Mev), and the creation of electron-positron pairs become favorable since the photon is no longer maintaining the uniform “free” sinusoidal motion it has. This may be a **fundamental limit on normal EM frequency, and a limit of length (and time) measurements using light**.

- This may also explain why the electron is the smallest “matter” particle found, since it is at the lower limit of photon energies where resonating fields would start wrapping around with full wavelengths.
- However, Gamma rays as high as the GeV and TeV range have been detected. While observing a Gamma Ray Burst from a distant Galaxy, named GRB 130427A, and just as the optical flash peaked, Fermi's Large Area Telescope (LAT) detected a spike in GeV gamma-rays reaching 95 GeV, the most energetic light ever seen from a burst. This relationship between a burst's optical light and its high-energy gamma-rays challenges the prevailing theory of how visible light from these bursts is produced. In addition, this extraordinary event enabled NASA's newest

X-ray observatory, the Nuclear Spectroscopic Telescope Array (NuSTAR), to make a first-time detection of a burst afterglow in high-energy, or "hard" X-rays after more than a day.

- Gamma-ray bursts are the most energetic form of light and the most luminous explosions in the cosmos, thought to be triggered when the core of a massive star runs out of nuclear fuel, collapses under its own weight and forms a black hole. The black hole then drives jets of particles that drill all the way through the collapsing star and erupt into space at nearly the speed of light. Hot matter surrounding a new black hole and internal shock waves produced by collisions within the jet are thought to emit gamma-rays with energies in the **million-electron-volt (MeV) range, or roughly 500,000 times the energy of visible light**. The most energetic emission, with billion-electron-volt (GeV) gamma rays, is thought to result when the jet slams into its surroundings, forming an external shock wave.



I presume that with such high energy exceptional sources, the relationship noted above for the EM oscillation fails, and a new non-linear regime enters into play, with new physics. $E=h\nu$ does NOT apply at those energies- the energy is emitted in a "singularity" form, as one lump, not oscillating at a particular frequency. The EM dimension is stretched to allow the one-shot energy to go through. Those energies are now measured from decay products, not via their frequency, and hence the extrapolation may be unjustified.

The new physics for high energy Gamma rays (which may not necessarily be high frequency Gamma Rays) would clarify a lot about the GUT energy range, but also provide a picture of how Protons and Neutrons form from Photon loops, with a higher energy (and smaller sizes) than our cutoff for photons found above. It may also explain why the electron is different from the Quarks (which form triplet representations of color $SU(3)$), with the new dimensions perhaps getting into play once the EM dimension is saturated. Once that saturation is reached, the new dimensions of Color may provide a new kind of “photon” in those dimensions. Frank Wilczek, in pondering what happens when you squeeze things too hard, sees a “cunning” combination that ties color and electromagnetism. “Just as in the electro-weak Standard Model both the original $SU(2)$ and the original $U(1)$ are broken, yet a cunning combination remains to become physical electromagnetism, so in the color-flavor locked state both color $SU(3)$ and the original electromagnetic $U(1)$ are broken, but a cunning combination remains valid. This combination supports a modified “photon”, part gluon and part (original) photon, that is a massless field.” “Specifically, some of the gluons become electrically charged, and the quark charges are shifted. The charges of these particles all turn out to be integer multiples of the electron’s charge!”



Wilczek

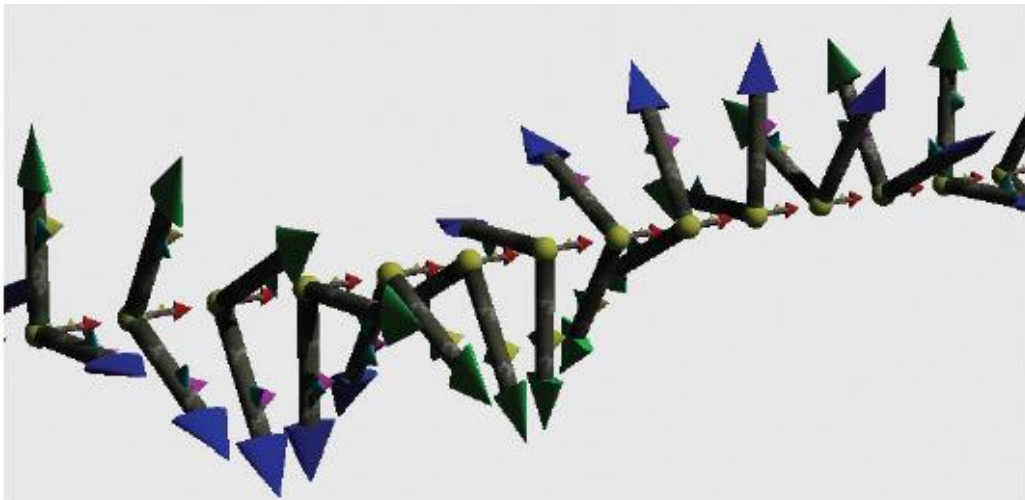
I think studying those high energy Gamma rays (and not just their by-products) will give us insights into the Photon above the frequency cutoff, as well as to the merging of QED and QCD in a PL world at high energy.



- There had been hints at this energy limit for “standard” EM waves. The early QM and nuclear pioneers had noted that “... The formulae which have been deduced from the quantum theory give for the probability of these processes values which, for sufficiently high energies, no longer depend upon the energy of radiation.” (Carlson and Oppenheimer). Oppenheimer continued: “Little evidence exists for the validity of the theoretical formulae for pair production by gamma rays of very high energy. The theoretical formulae hold quite well up to 10^{*7} volts, but beyond there are no definite tests of the formulae.” 10^{*7} volts, by the way, is very close to our proposed cutoff limit. One more suggestion: this limit indicated above by the formula for the photon wavelength, may be what is needed to justify “renormalization” and the cutoffs used

in QED to tame the infinities, something that works, but is now done without a theoretical justification.

- Another idea proposes itself: If the speed of light is the result of the “pressure” resulting in the sinusoidal motion of the PLC cluster, then at the EM limit above, this speed may no longer apply! Look for measurements of the speed of light at these high energies to deviate from “c”.
- Nevertheless, we have to consider that in a relativistic view the length and time of a photon are irrelevant, as time and distance are immaterial to a photon at the speed of light. In the context of our later discussion about reality, we can say that Light appears as if discrete and indivisible, possessing well defined properties, upon detection and measurement, while in transit (i.e. between interactions) it has a life of its own where length and time are immaterial.



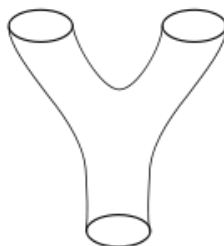
“Q: How do you make a photon twice as big? A: Chop it in half”.

– John Duffield, Physics Discussion Forum (PDF) (Farsight)

Takeaway: Photon Length decreases with increasing energy. At energies close to that of an electron, the photon length is less than its wavelength. This should create non-linear dynamics, and result in looped configurations – matter. At very low energies, the dynamic pressure of the EM dimension becomes too low to sustain the EM oscillation, and results in alternate presentations, possibly as dark matter.

5.2.2 - PHOTON FLUID

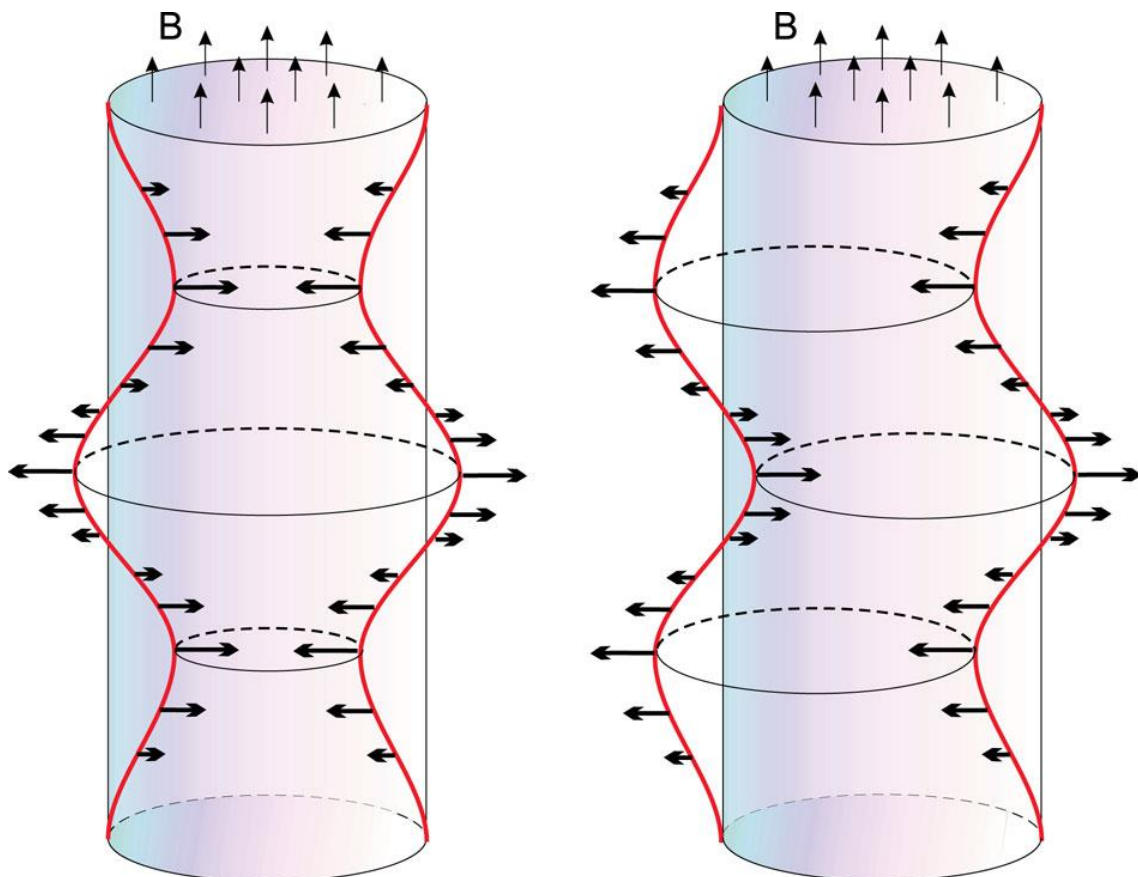
- We can see this “Wave” frequency action as a “PL Pressure” effect, the higher rate of PL creation causing a pressure to disperse (a Hilbert space diffusion), that results in the wave of PLs propagating- **the higher the pressure, the higher the frequency** (PLs moving at the speed of light) of the wave.
- The PL pressure is due to the number of PLs available at any time. The higher energy photon has more PLs. This stress is there at the emission of the photon, and once the photon is released, that “momentum” continues, and the photon goes into its continuing oscillation, preserving the frequency of its creation. In fact, since the photon when being emitted is converting “matter” into free energy, it will tend to take that initial frequency from the frequency and configuration of the “matter” (trapped resonances themselves).
- So a particle and antiparticle turning into energy basically create two identical sets of photon PLs, which now flow linearly instead of rotating. The combination basically “splits” into two identical photons, like a DNA helix unwinding its two pairs (in this case creating a *new* pair), going in different directions to conserve momentum, conservation of energy and momentum being the property of iso-morphic “space”.
- Conversely, particle creation from energy would require the combination and reconfiguration of PLs, with the new “rotating” photon loop becoming “matter”. This has to happen also by creating two identical particles, with a configuration that preserves the initial momentum, hence creating an opposite charge and rotation – a particle/anti-particle pair.
- In the above processes, the particles/photons merge in the intermediate step, their PL components flowing together before reforming a new configuration.
- Compare this picture to String theory’s loop strings joining to become one loop string, or splitting one string into two strings.



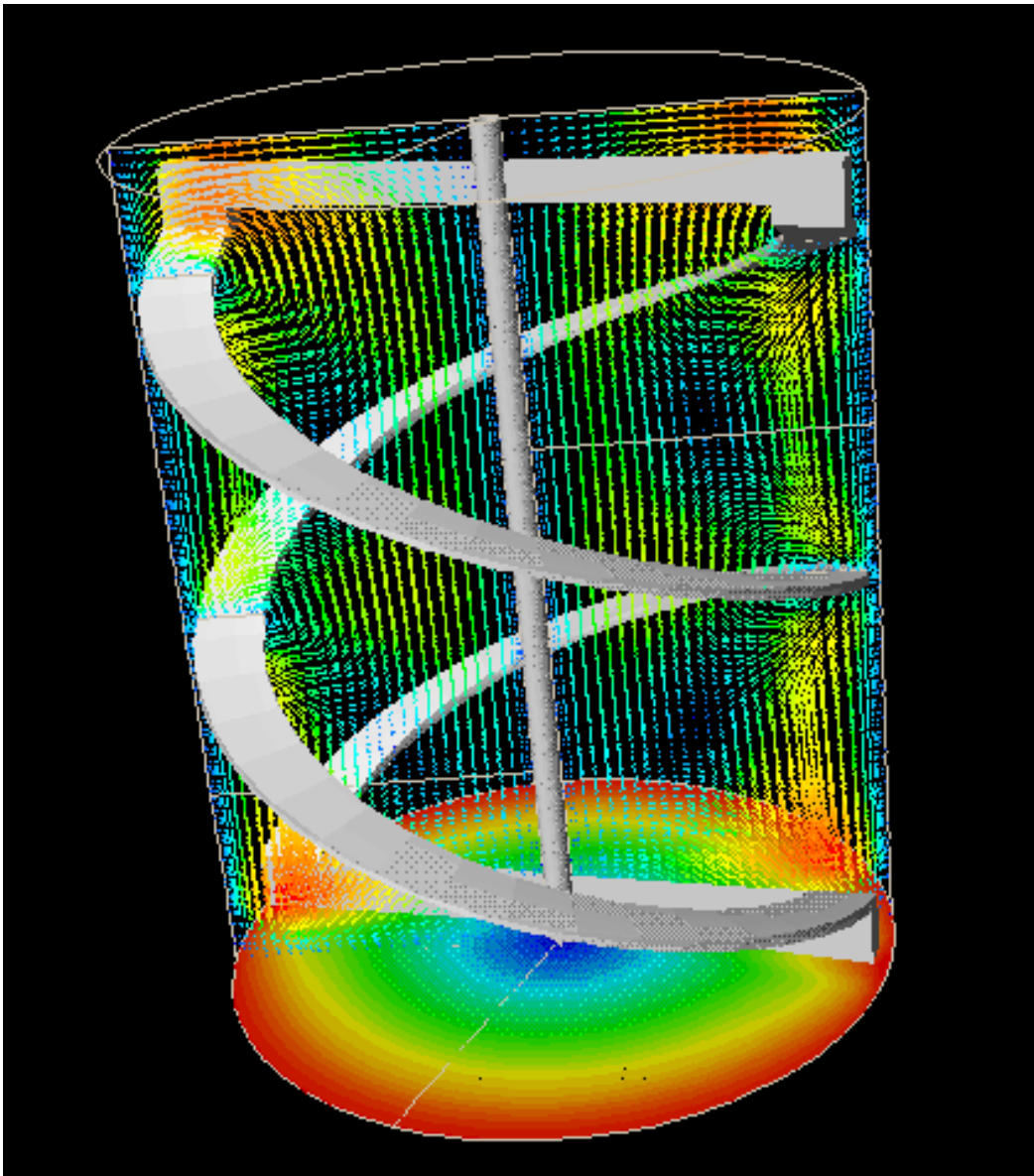
- A photon has twice the “effective mass-energy” in mc^2 (m being proportional to the number of PLs) you would assume from the kinetic energy equation $\frac{1}{2} mc^2$ (if it had no rest mass energy component). And since PLs are what warps space, perhaps that is why light bends twice as much in an eclipse than the expected rate from Newtonian mechanics? Okun is more clear on this. Relativistically, “the resistance of a body to the force accelerating it depends on the angle between the force and velocity. ... It is meaningless to speak of the gravitational mass of a photon if for a vertically falling photon this quantity is half that for one traveling horizontally. ... It is easy to show that a system of two photons will have zero mass only when they move in the same direction”. Clearly, the “mass” of a photon, representing its inertia, is a dynamic value depending on its interaction with the Ether/Gravitational field.
- The higher number of the PLs in their rotation creates a higher “PL gas pressure”. In this sense, the PLs act as a “gas” or **Fluid in Hilbert Space**, whose motions are influenced by its density and pressure. Einstein’s starting point for studying Photons & Radiation was through Gas Dynamics. This “faster rotating” PL disc represents the pressure for generating PLs in subsequent clusters as the PLs move in and out of existence- compare Takehiko Takabayasi’s idea of the “stress” being related to the “derivative” of the fluid density.
- The “fixed nugget” per oscillation can be compared to a dripping faucet, a “Space Spigot” if you will, where the flow of PLs through a space node is limited such that an energy nugget (a packet of PLs) goes through it in each oscillation, sort of like fixed-size water drops coming out of a faucet, the more water going through (higher energy flow) the higher rate of drops (frequency) coming out. Think of this “drop” of energy as a set of correlated PLs that jump the node together when they reach a “critical mass”.

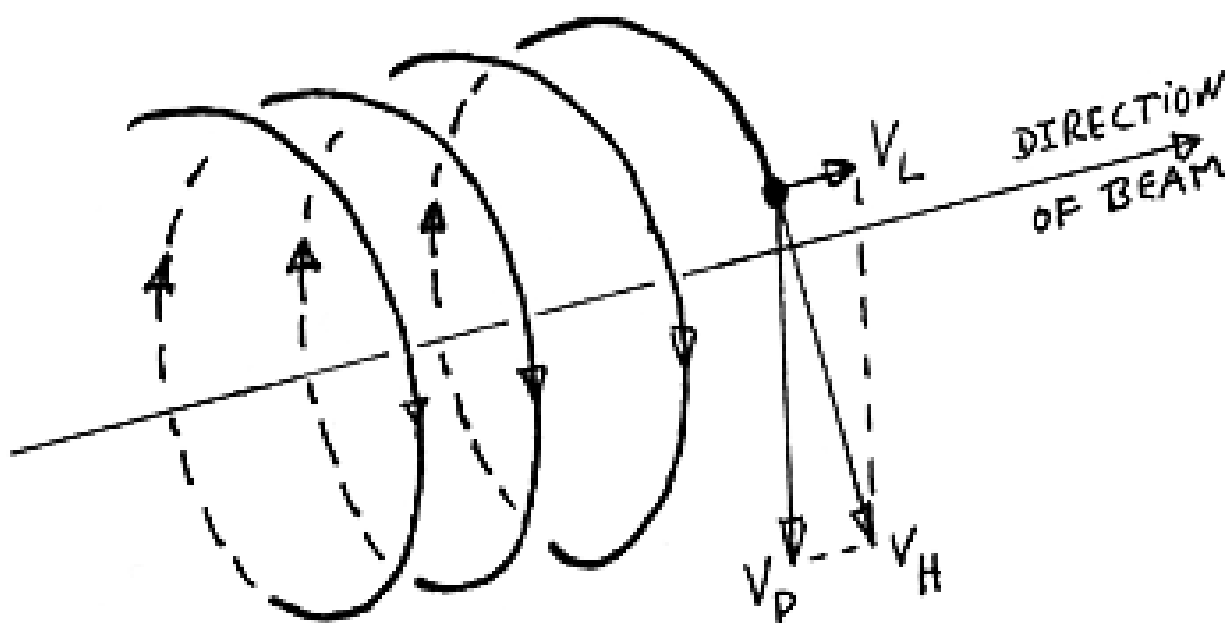
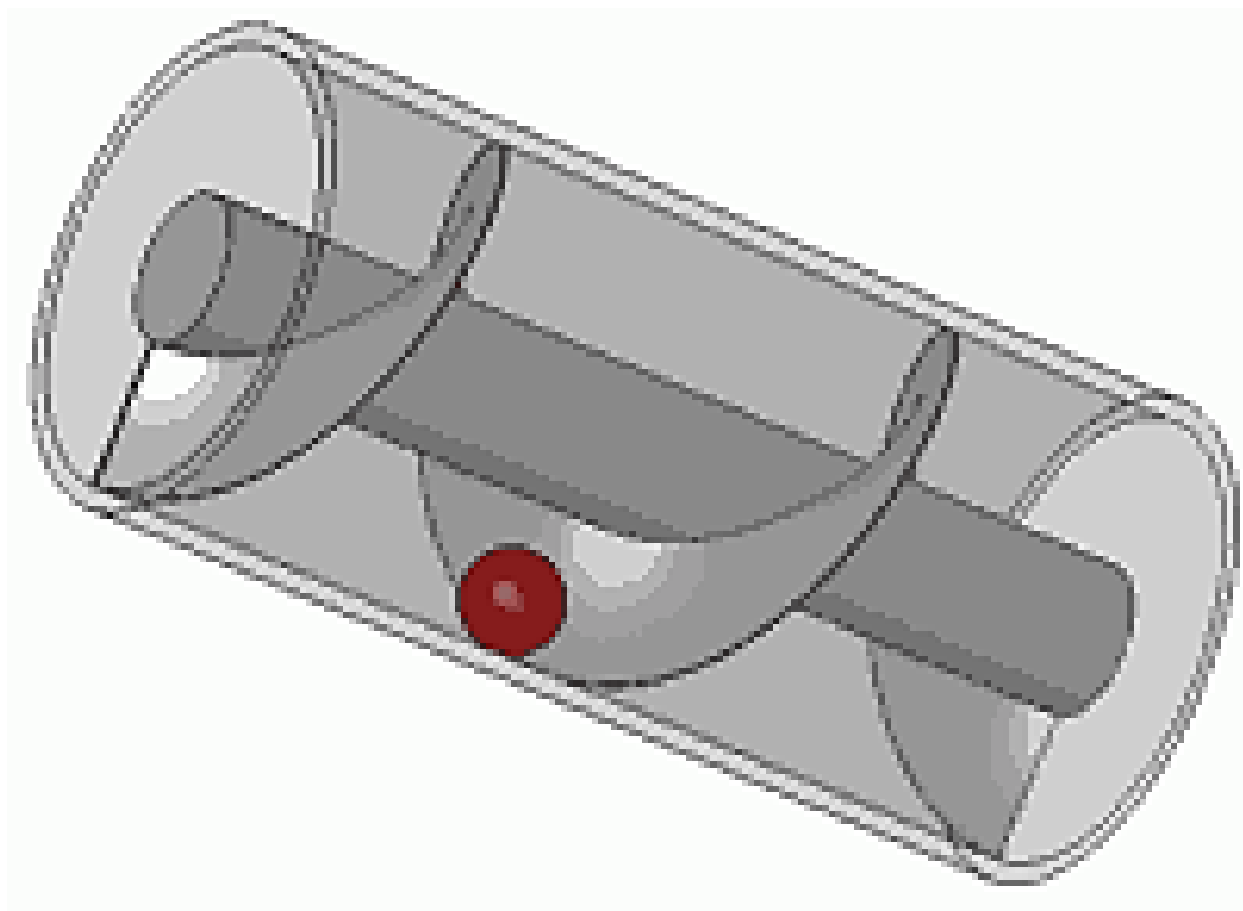


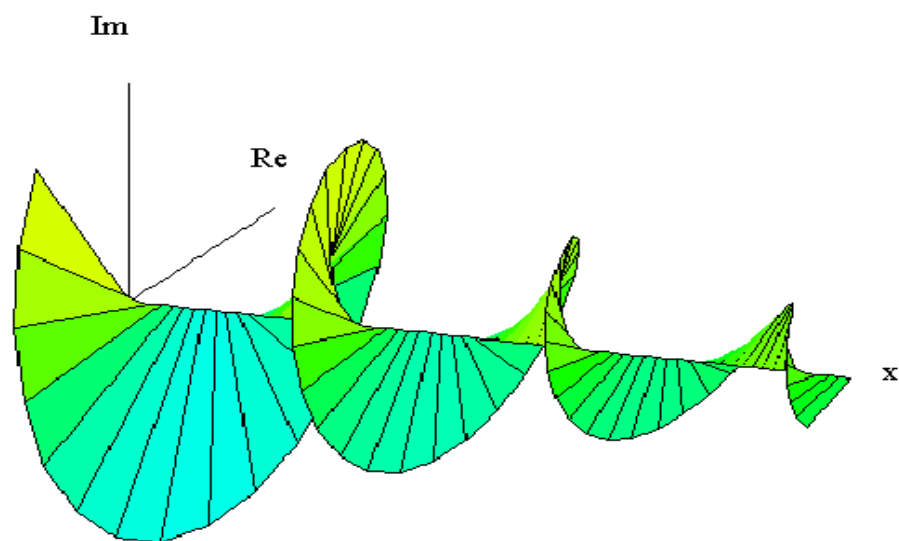
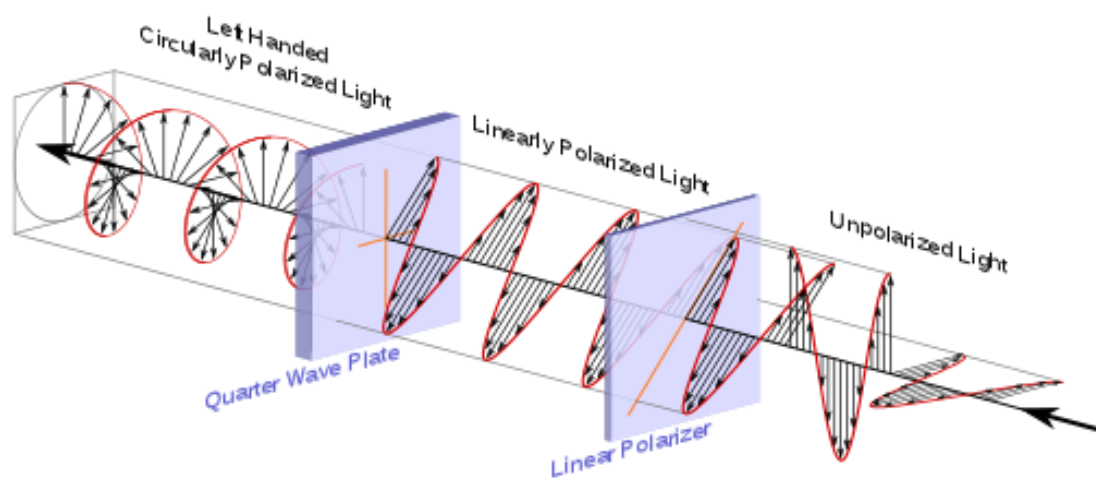
- The comparison to fluid dynamics and Gas Thermodynamics should afford simulation opportunities. While Schroedinger maintained that everything is a “wave”, our “particles” being “wave packets”, Madelung confirmed that Schroedinger’s equations can be derived from Hydrodynamic equations of a continuously distributed “electricity” with a mass density proportional to the charge density. Takehiko Takabayasi saw the “quantum potential” as originating from an internal stress in the “fluid” (the “pressure” above), this stress depending on the derivatives of the fluid density. Bohm and Vigier, bringing back the Ether (our PL space), saw this “background medium” forming particle-like inhomogeneities in its otherwise chaotic ubiquity. Similarly, Janossy and Ziegler-Naray saw the “quantum mechanical potential” as a classic potential driven by this interior force (“pressure”) producing the acceleration of the “fluid”. In their view, Planck’s constant can be seen as a constant describing the elastic properties of the fluid. Jayne’s linkage of information theory and statistical mechanics proposes similar interpretations to Schroedinger’s wave function. A study of Magneto-Hydrodynamics should provide illuminating insights.

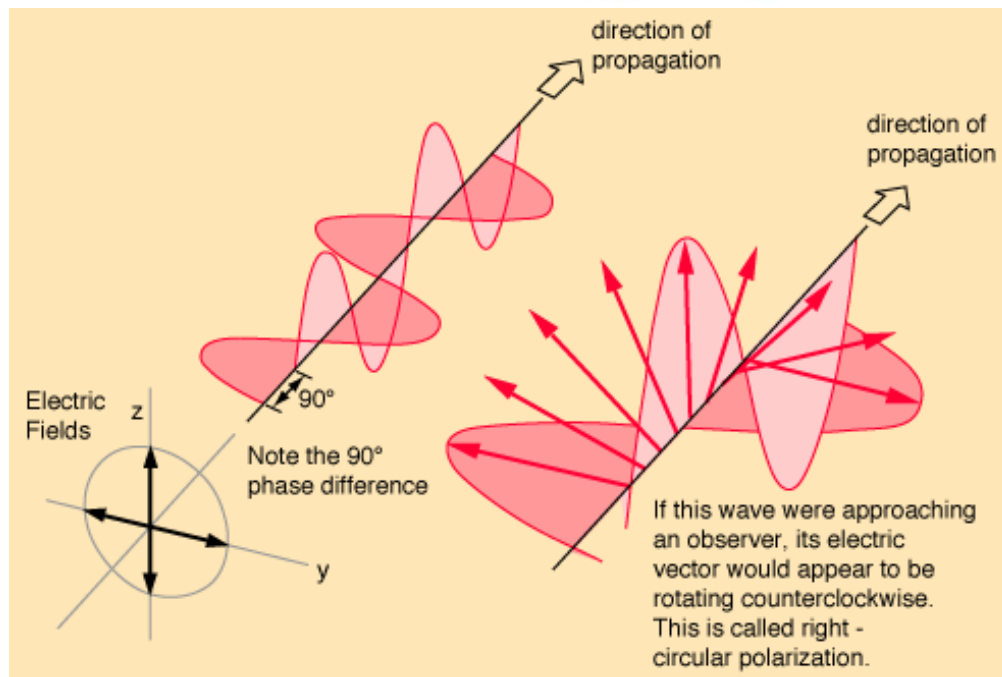
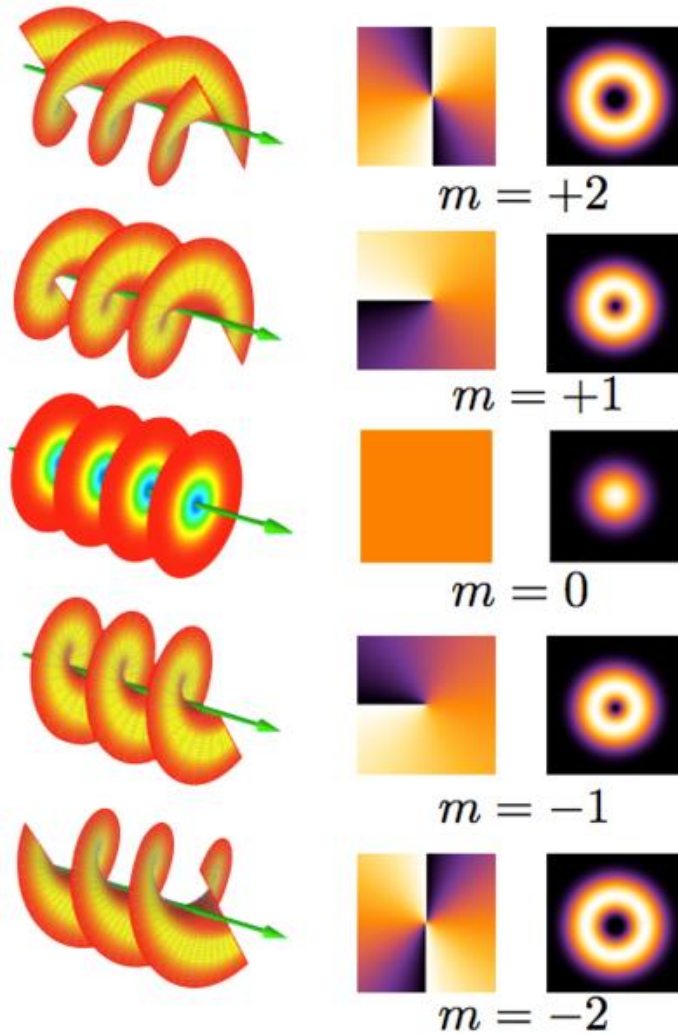


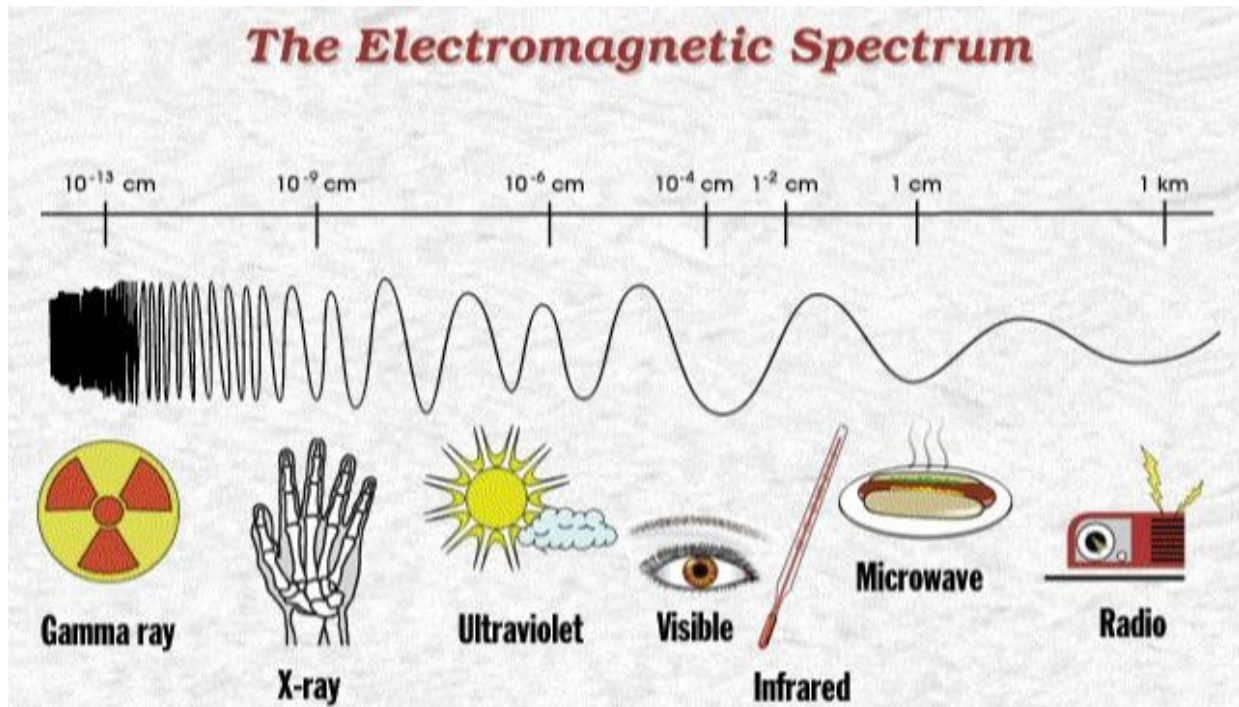
- You can think of the Photon as an oscillator, its Energy density as the tension, swinging the PL density back and forth in/out of the Nil-Source. This is a version of QM creation/annihilation operators in action. The Frequency of the oscillation, driven by the PL pressure, increases with the tension in a linear fashion, at least in the current Universe (Singularities with much higher densities presenting a non-linear aspect leading to Inflation).
- An Archimedes screw would give a pictorial view of this pressure pushing the flow forward, although not an exact replica since the screw “wavelength” is fixed in this case. A twirling ribbon maybe a closer approximation.





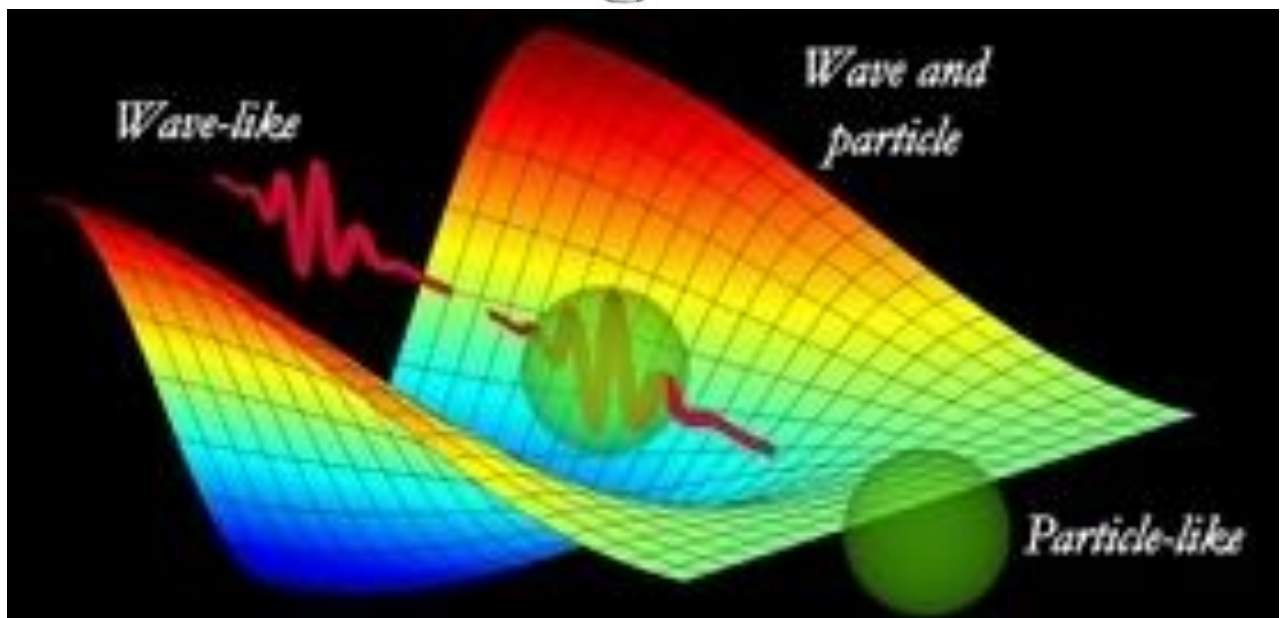






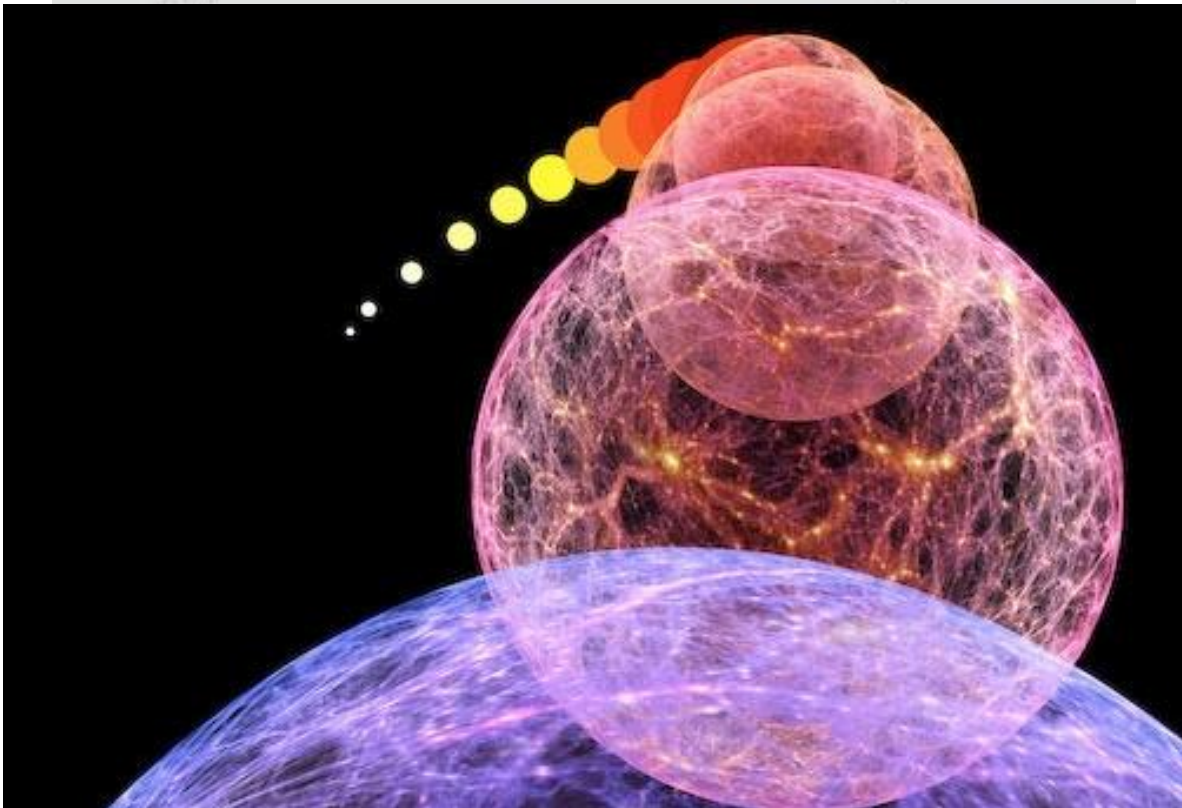
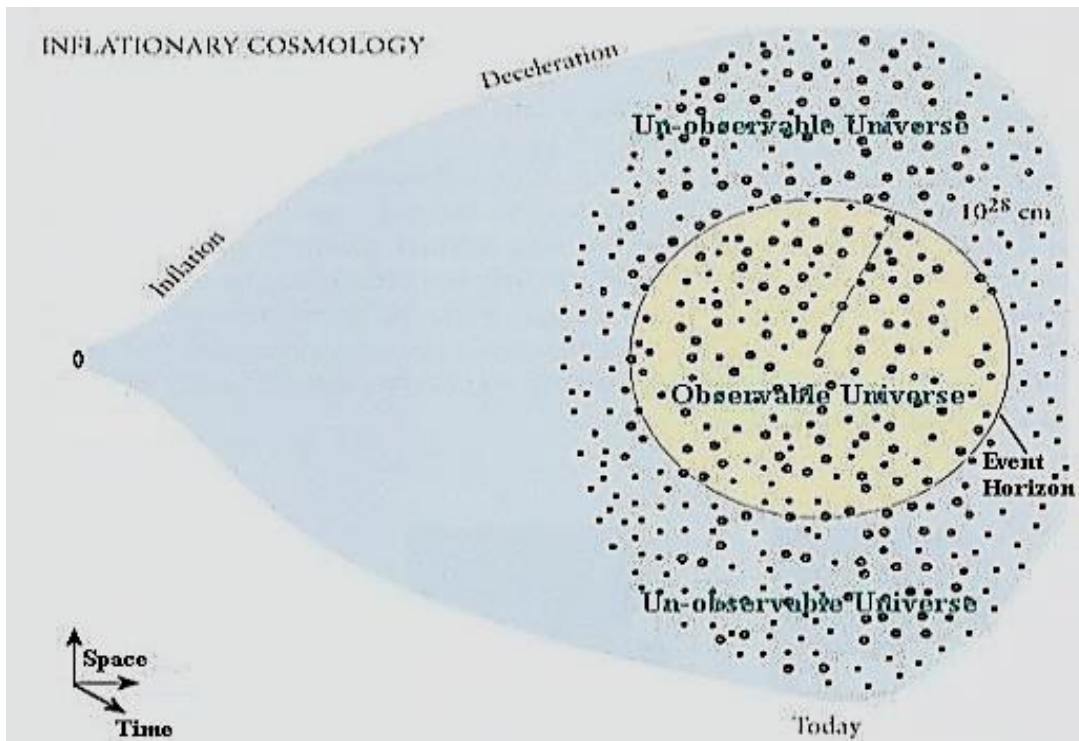
- This Packet formation would also create a “deformation” in the space... the higher the PL density (Energy Density), the larger the space deformation/compression – in accumulation causing the space warping of “Gravity”. As someone aptly said: “Gravity is not real, it’s just our dumbed-down interpretation of space-time curvature.”
- Even though the Photon has a defined length and duration, it is still one entity, controlled by its configuration in the Netherworld. When a Photon “touches” a detector and is absorbed, the configuration forces the absorption of the Entire Photon. This makes the impact look like that of a point particle, even though the Photon wavelength may be larger than the impacted particle.
- The defined size nuggets of each oscillation would reflect a saturation of space flow rate for the PLs. It is conceivable then that at below a certain energy level, this saturation is not reached, and hence the “flow” is no longer saturated and may not exhibit the oscillating electromagnetic aspects seen in photons. Continuing with our Dripping Faucet analogy, a low enough pressure reverts to a low continuous leak, with the PLs streaming out smoothly through space, not in the waves of Radiation. This would indicate that there is a “minimum frequency” level below which EM waves no longer exhibit their normal behavior, perhaps providing a more linear energy profile. This would be the case for the

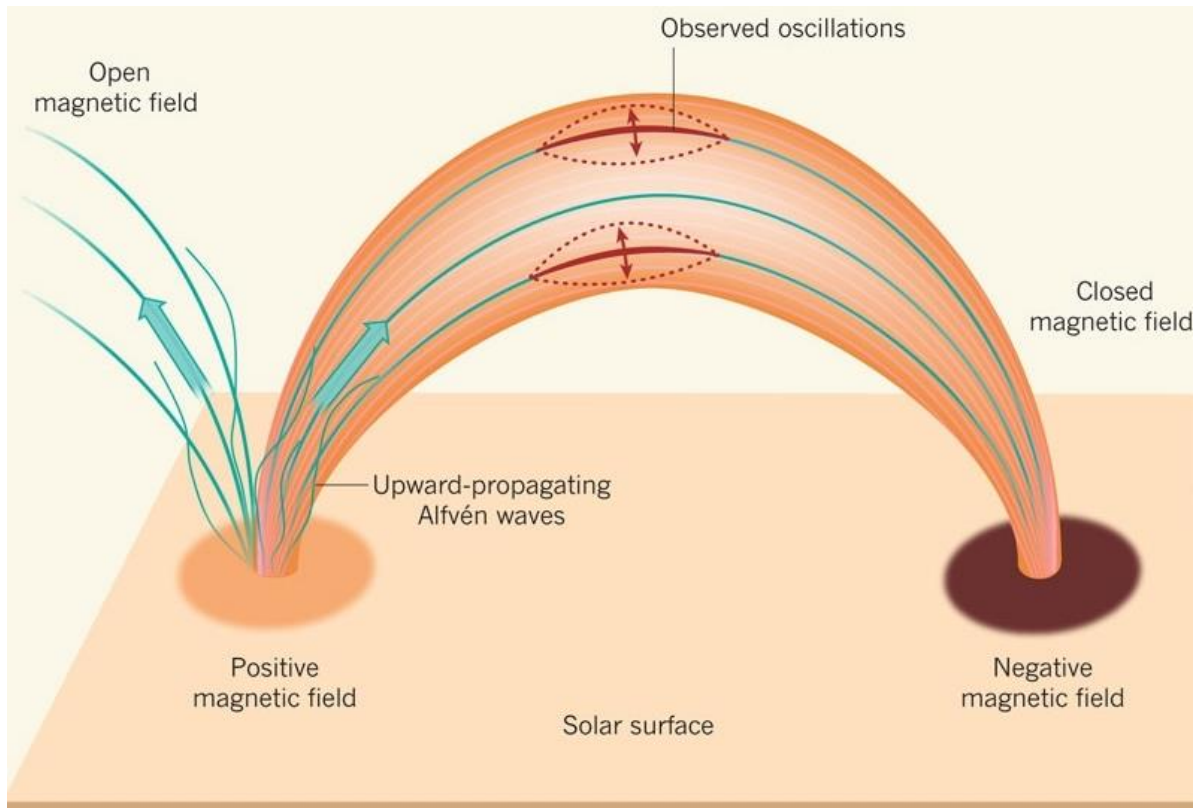
“Vacuum Energy” and “Dark Matter” low PL densities, whose low levels would lead to low uniform distribution, whose flows/motions would not reflect our concept of EM waves, and would thus be undetectable to our instrumentation.



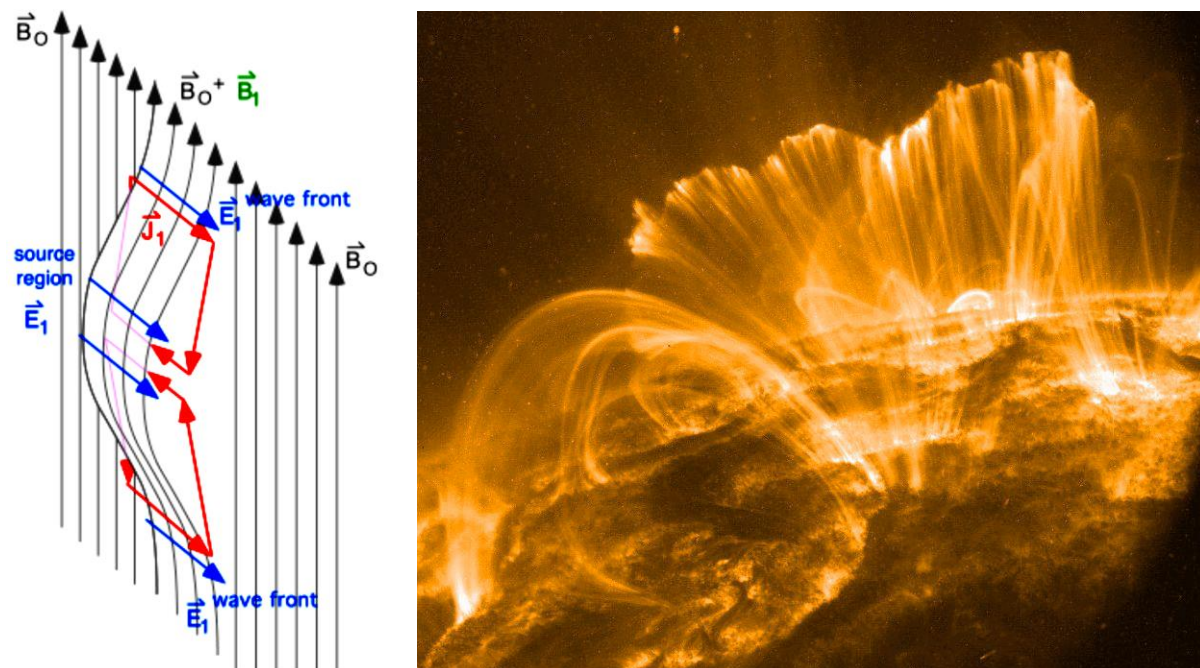
- This would also indicate that for extremely high energy levels, when the oscillation wavelength become comparable to the minimal inter-nodal distances, normal EM flow of energy reaches a limit, and the energy flow cannot continue in its sinusoidal nugget manner. At that stage, new phenomena and non-linearities would appear- such as the PLs creating

additional nodes of space to deal with the over-saturation... a clear parallel to the Inflationary expansion at the initial high Energy beginnings.





- And in the usual vein of nature repeating its successes at multiple levels, the Alfvén waves on the surface of the sun simulate macro-photon effects on a large scale. The Oscillating flows of electromagnetic energy reflect a magnified version of EM energy waves.



5.2.3 - CAVEAT EMPTOR

On Einstein's urging, Rupp had measured and confirmed the finite emission times of atoms, confirming light's wave nature in emission and absorption. No instantaneous quantum processes of emission were noticed.

Also on Einstein's urging, Bothe had confirmed that a single emission act results in a single absorption act, which confirmed the light-quantum (corpuscular) nature of light. At a minimum, it had to be "an elementary bundle" having a small frequency band, a large coherence length and a small angle of aperture. "One may say that the light-quantum jumps". "One may see an indication that light-quanta need not possess less reality than electrons".

The nature of Light holds the key to the mystery.

After all these musings, it is always well to remember Einstein's dictum: "All these fifty years of conscious brooding have brought me no nearer to the answer to the question, 'What are the light quanta?'. These days, every Tom, Dick and Harry thinks he knows what a photon is, but he is wrong".

Conversely, as Roy Glauber paraphrases, "I don't know anything about photons, but I know one when I see one". I don't even have a licence from Willis Lamb to speak about Photons (he thought the word should be removed from the Dictionary, given its wide range of meanings, and only specialists should use it).

It is not an exaggeration to say that the Photon holds the key to our understanding of creation. It is the main component of radiation and matter, controls the Universal speed limit, seems omnipotent in space and time, and defines our space and energy. If the above discussion helps us "visualize" a photon world, even with potential details unresolved, it would help clarify the picture of our world.



The first "molecules" made from two photons have been created by physicists in the US. Their experiment involves firing pairs of photons through an ultracold atomic gas, where an attractive interaction causes the photons to stick together and become quantum-mechanically entangled. The breakthrough could allow both conventional and quantum computers to encode and process information using photons. Getting photons to stick together is not easy because they normally pass through each other without interacting. However, a photon has an associated electromagnetic field that can modify its surrounding medium. These changes can affect nearby photons and create an effective interaction between them. Although this effect is usually tiny, the interactions can be significant if the medium is chosen carefully.

5.3 - PHONONS, SHMONONS!

Nature is a kind teacher.

It constantly gives us clues in our search for answers. An interesting analysis of the history of magnetism asks the question: what if there were no lodestones here on earth? It was these lodestones and their mysterious properties that started us wondering about magnetism, and got Gilbert and others to investigate their properties. Those lodestones were apparently built by a kind of bacteria that fed on magnetite, creating those strips of magnetically aligned stones that the ancients wondered about. If it wasn't for the "accidents" of the creation of those bacteria, the subsequent creation of lodestones, and the inquisitive minds of our ancestors (who used them to great effect in compass needles, etc to advance civilization), we may not have found out about electromagnetism, at least not in the same timeframe that we did. Civilization would have been a lot poorer for it.

A corollary of this is that on habitable planets where this accident had not happened, life may not have advanced to where we are, and may never do. This may be why there may not be that many advanced civilizations out there. In a similar vein, one wonders what other "accidents" of nature are NOT available on our planet, with interesting features we have not yet seen, and therefore we may be missing on some other amazing feature of nature, equivalent to electromagnetism! We are curious fellows, but our curiosity is usually aroused by our senses, by what we observe. If the mystery is not within our view, we are usually not aroused. Out of sight, out of mind, as they say.

Back to the subject at hand.

Phonons, named so in recognition of their similarity to Photons, are another example of Nature repeating its tricks at all levels. It is another clue that kind teacher may be giving us to the nature of Photons.

A phonon is a quantum mechanical description of an elementary vibrational motion in which a lattice of atoms or molecules uniformly oscillates at a single frequency. In classical mechanics this is known as a normal mode. While normal modes are **wave-like phenomena** in classical mechanics, **phonons have particle-like properties as well in a way related to the wave-**

particle duality of quantum mechanics. There are acoustic and optical phonons, of similar behaviour. Think of the “Phonon” as “the particle” of heat.

Comparison of Phonons & Photons

PHONONS

- Quantized normal modes of lattice vibrations. The energies & momenta of phonons are quantized

$$E_{\text{phonon}} = \frac{h\nu_s}{\lambda}$$

$$p_{\text{phonon}} = \frac{h}{\lambda}$$

Phonon wavelength:

$$\lambda_{\text{phonon}} \approx a_0 \approx 10^{-10} \text{ m}$$

PHOTONS

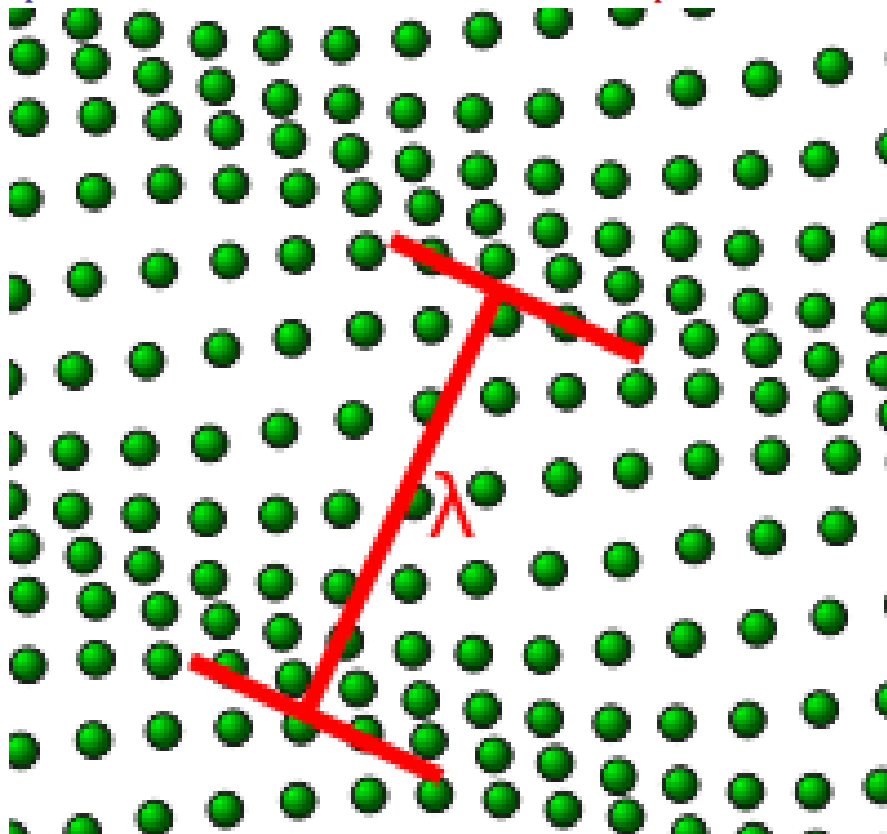
- Quantized normal modes of electromagnetic waves. The energies & momenta of photons are quantized

$$E_{\text{photon}} = \frac{hc}{\lambda}$$

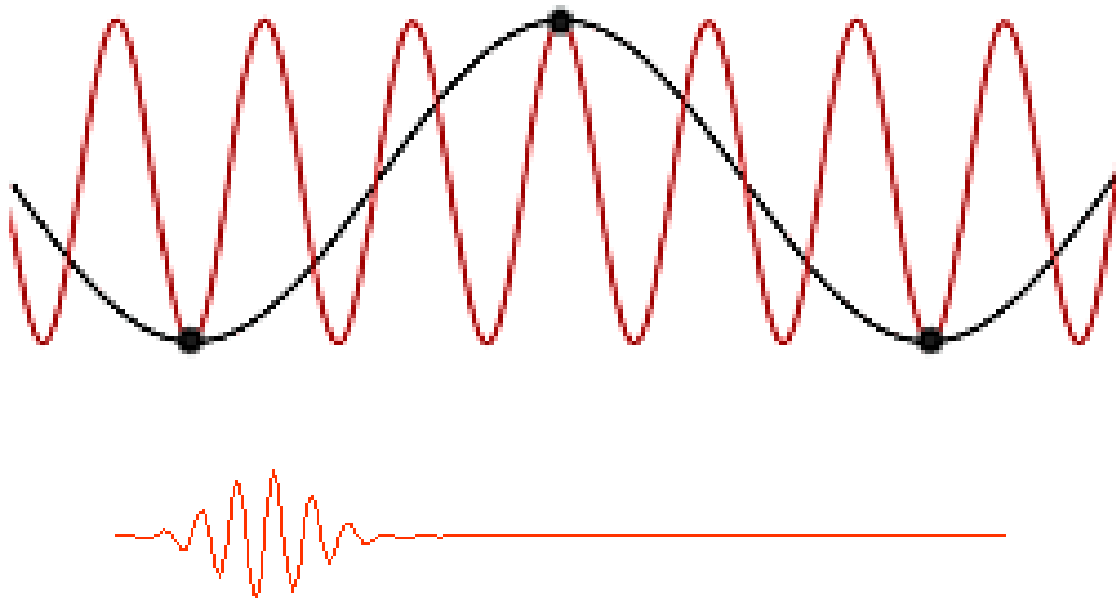
$$p_{\text{photon}} = \frac{h}{\lambda}$$

Photon wavelength (visible):

$$\lambda_{\text{photon}} \approx 10^{-6} \text{ m}$$

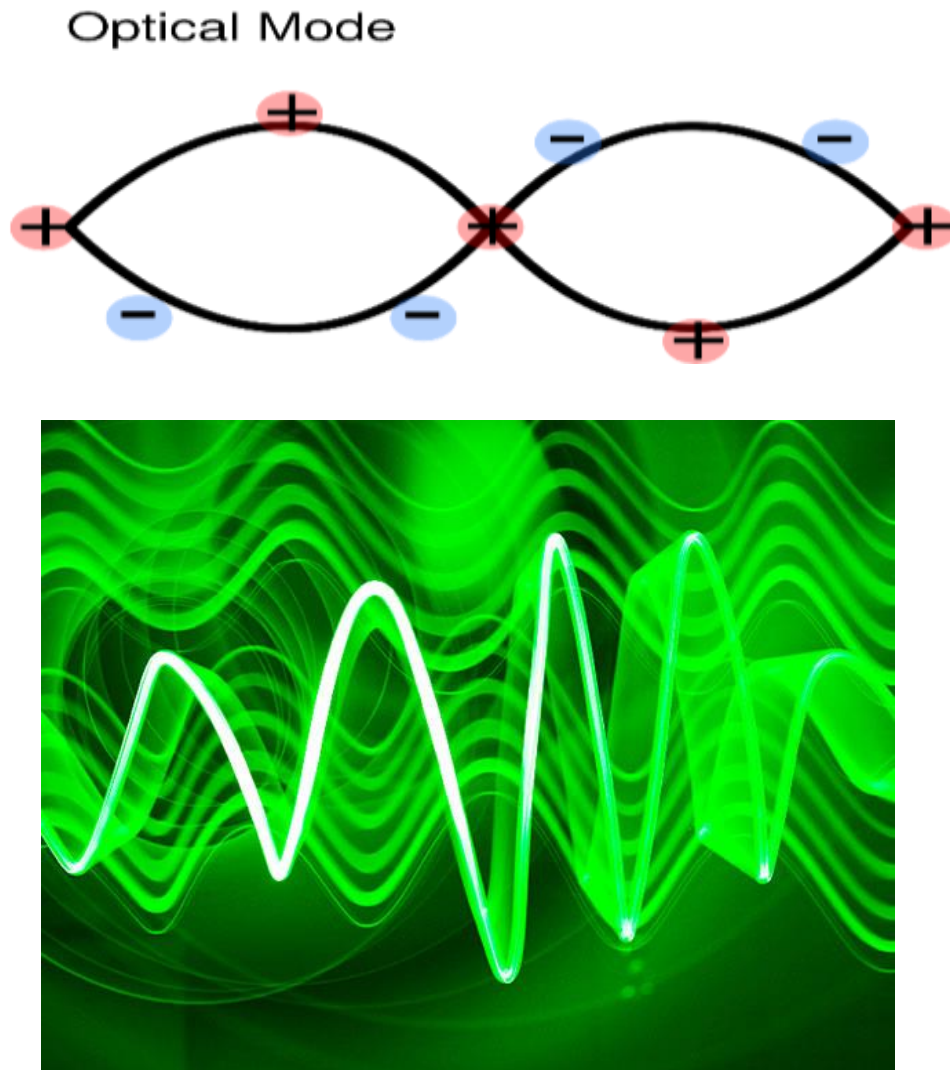


If you look at the atoms as our PLs, our own “atoms of existence”, you have an almost identical picture. The momentum $\hbar\mathbf{k}$ (\mathbf{k} being the wavenumber) is exact, and by the uncertainty principle, the position of phonons cannot be determined, and so, phonons are not localized particles. Nevertheless, just like the case with photons or electrons, a fairly localized wavepacket can be constructed by combining modes of slightly different frequency and wavelength. By taking waves with a spread of \mathbf{k} of order $\pi/10a$, a wavepacket localized within about 10 unit cells is made, representing a fairly localized phonon with group velocity $d\omega/d\mathbf{k}$, within the limits of the uncertainty principle. Like photons, phonons are bosons and not conserved; they can be created or destroyed in collisions.



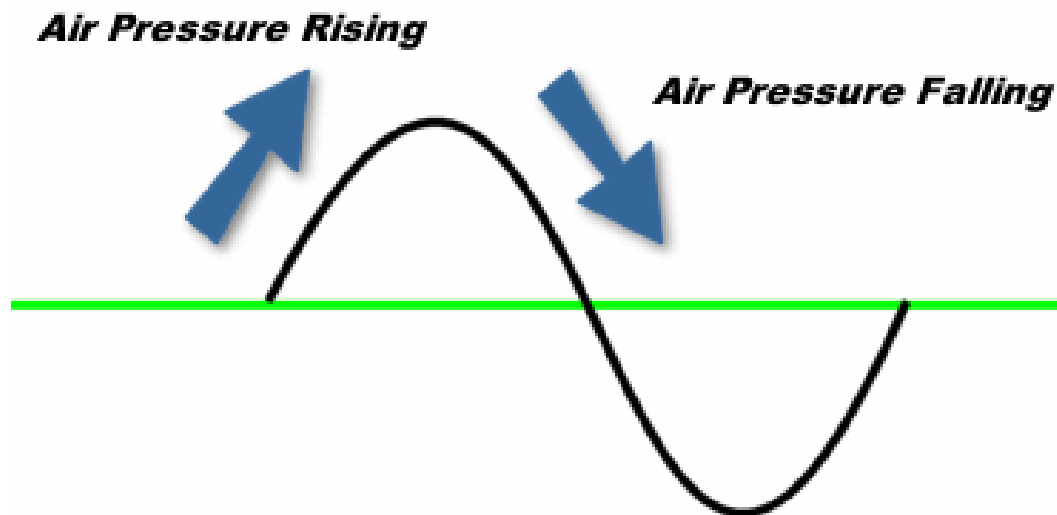
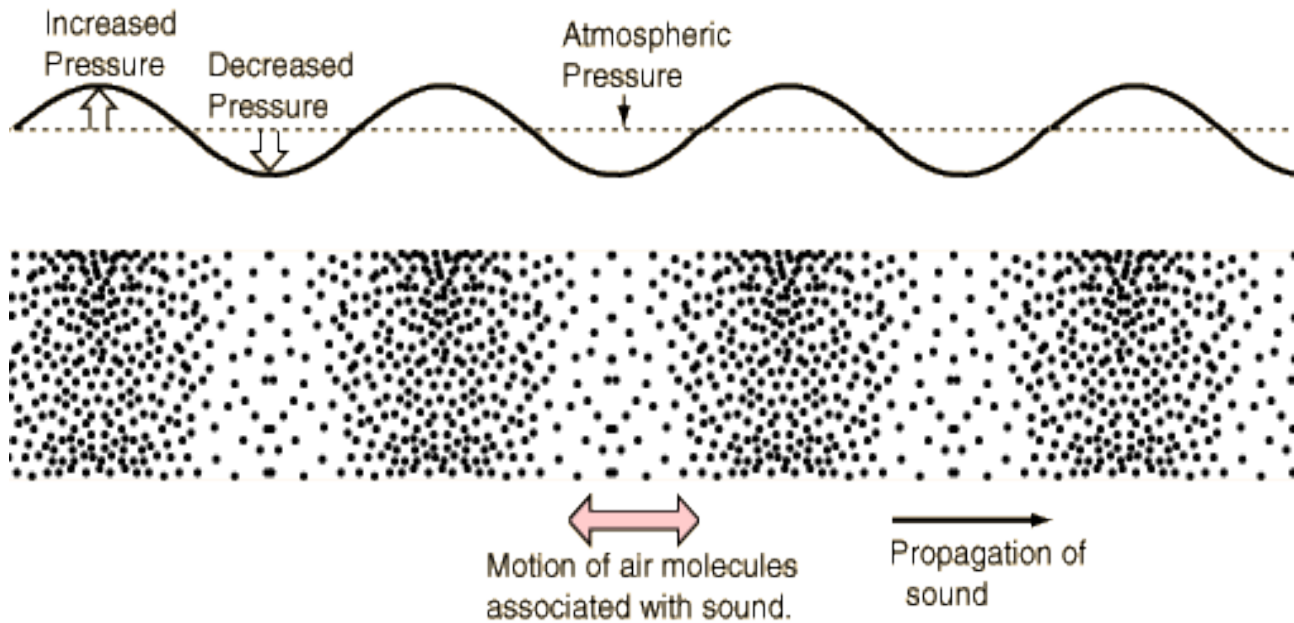
The “speed” of a phonon is the speed of motion of the “group” of waves, not to be confused with the “phase” velocity of the individual waves, which can be “super-luminal” (faster than light). Could this “superluminal” phase velocity, $w=c^2/v$, be the speed of “entanglement” of the wavefunctions of entangled particles? Since for photons $w=v=c$, this needs a closer look.

So we have here a “picture” similar in many respects of how a Photon must look. It may not be a duck, but it walks like one, quacks like one, so must be of the same family.



Debye saw the similarity. The Debye model is a solid-state equivalent of Planck's law of black body radiation, where one treats electromagnetic radiation as a gas of photons in a box. The Debye model treats atomic vibrations as phonons in a box (the box being the solid). Most of the calculation steps are identical.

In a similar vein, acoustic waves in the air result from “pressure” variations in the “air” lattice. The **speed** of propagation is fixed by the properties of the air, while the frequency, **amplitude and energy** of the wave are related to the “strength” (pressure) of the disturbance. Again, a parallel to our PL picture can be made, with Photons being the “sound” of PL waves in the “air” of space.



Takeaway: Nature scales its behavior at all levels. The phenomenon of Phonons is a macro parallel to our view of a PLC photon. The equations are very similar, and should teach us many lessons from its analogies.

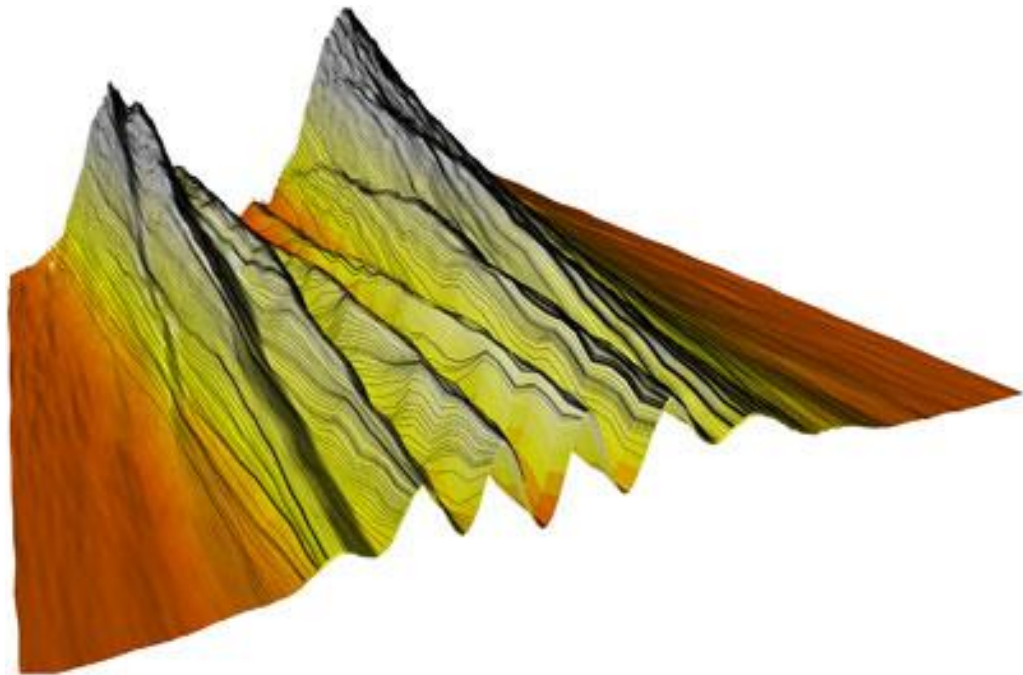
5.4 - A PHOTON'S LIFE

A few thoughts on a moment in the life of a photon.

When a photon is “emitted” (in our theory “released” from its resonant “material” trap), it shoots off at the “speed of Light”, its own unique speed, the ultimate speed limit of the Universe.

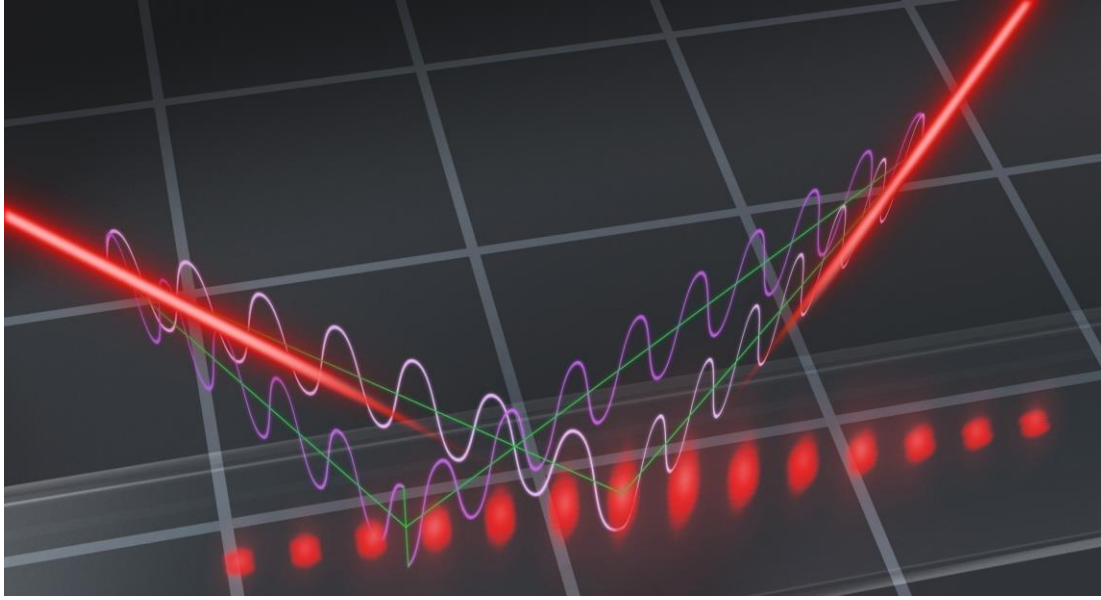
At that Speed, Relativity tells us that no time passes, and the world around the photon is infinitely contracted to a point.

At the risk of Anthropomorphizing nature again, what does the “free” photon “see”? Well, no time passes between its emission and its absorption. It is absorbed the same instance it is emitted, from its point of view. It crosses the Universe from source to sink instantaneously – not something it could brag about, since it sees the Universe as a small point.



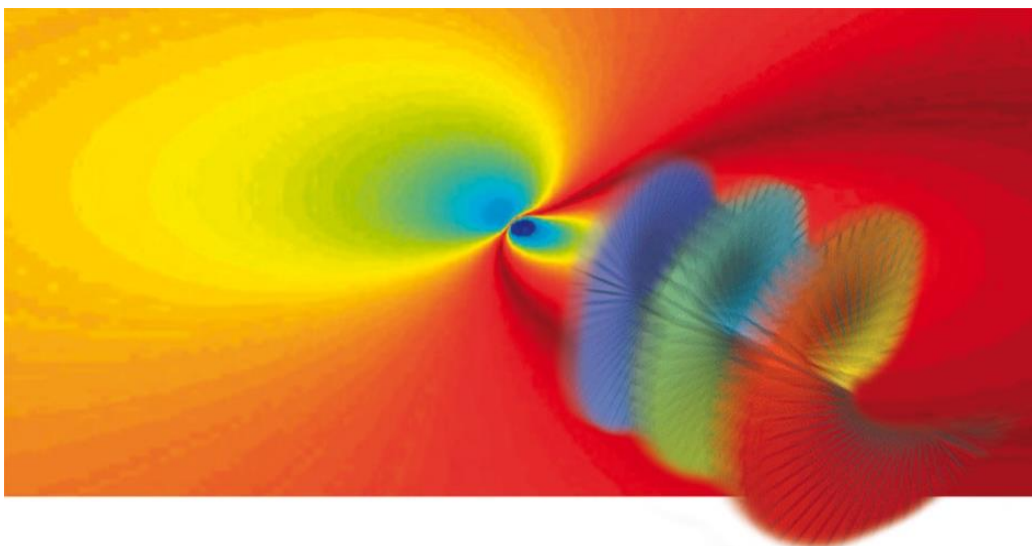
3-D plot of a photon wave

In a sense, we may think of the Photon as an ephemeral entity, not real, moving energy from one spot to the other instantly. “Seeing” a photon is a destructive event, absorbing it and “destroying” it. In that sense, it has the same status as “Force” – a mathematical contrivance that comes as a middleman in the equations, but is left out of the results. The Photon being also the “Force Particle” for EM interactions reinforces that concept.



But unlike “Force”, there are other reasons to see Photons are real. As the carriers of “Energy”, they are all there is to existence. While it is difficult to imagine their transport modes properly, and to tie it to the causality and perceived time-delays of our classical view, this does not remove their role of transport of an “effective” entity, “Energy”, or PLs. The emergence of causality, and classical “Time”, is an emanent concept, constructed by our minds, to comprehend the interrelationships of existence. De-constructing this mystery requires the convergence of many ideas, like Relativity, Entanglement, and multi-dimensional constructs.

For something that lives but an instance, and crosses the Universe in a jiffy, the Photon remains the most perplexing mystery to unravel.



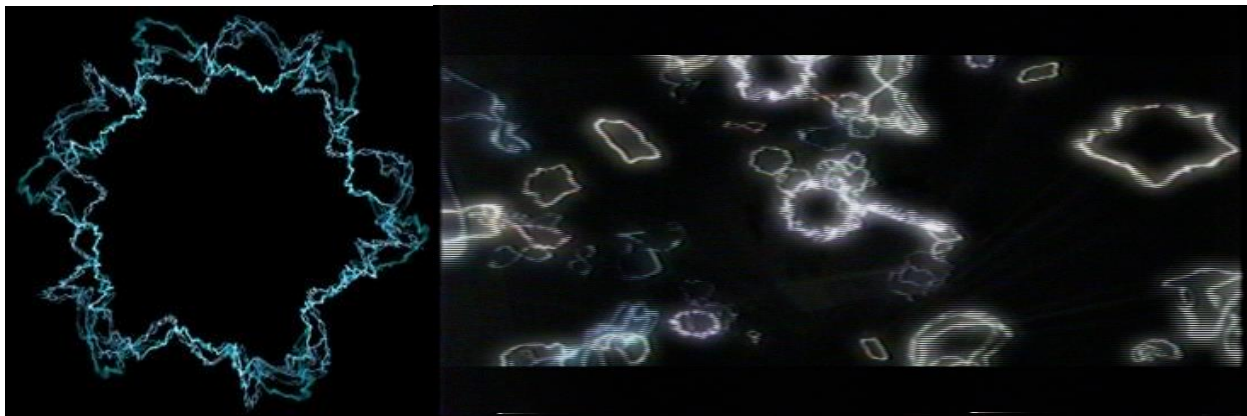
5.5 - STRINGS?

“The Book is not Finished, the Last Word is not Witten” – Glashow

With the Photon “Oscillations” driven by PL pressure, it behaves like a Harmonic Oscillator in flight, the frequency proportional to the tension. Each wavelength carries a fixed nugget of energy. We also determined that the Photon packet length is fixed.

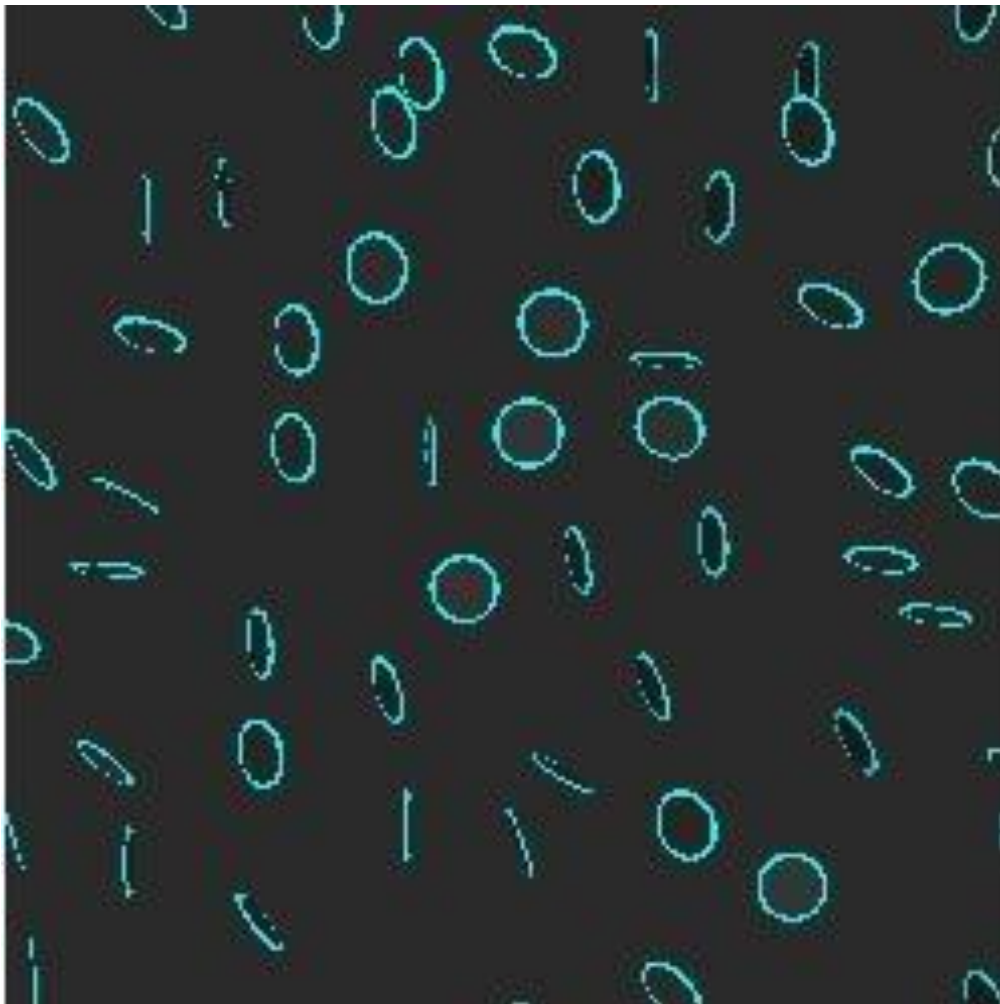
Is that what a Photon “String” would appear like? It would be an open ended string. An Electron, however, which we took to be like a wound Photon (see Appendix), could be visualized as a closed string vibrating in a similar fashion.

Perhaps a link can be made to String theories conceptually, that would then benefit from the wealth of mathematical structures provided by M theory and its affiliates.



The World of String Theory has become a closed world almost detached from reality. You get the feeling (aside from the Hubris: “String Theory is the Only Game in Town”... a replay of the Copenhagen Interpretation advocates’ ‘[C.I.] is not just one among many interpretations, it is the only one’ (Rosenfeld)) that String theorists are just talking to themselves. On celebrating the still undefined M-Theory, a noted String theorist writes: “It has been established, to the *satisfaction of most String Theorists*, that when the exact equations *are understood*, they will show that all five string theories are actually intimately related”. Like a Religion expounding details of its theology, the details get murkier and further detached from common experience and it becomes an object of its own- the following quote from a famous theorist describing the lack of visible effects of any Tears in the Space Fabric: “This is one of those rare instances in Physics in which the lack of a striking observable

phenomenon is cause for great excitement. The absence of an observable calamitous consequence from such an exotic geometrical evolution is testament to how far beyond Einstein's expectations string theory has gone". No Kidding. "Nothing" seems to be the theory's major achievement. Later in the same thesis: "Beyond a hodgepodge of properties, *no one knows what this eleven-dimensional theory is.*" (Italics his). The multiplicity of String Theories brings to mind Stanislaw Lem's (The Third Sally) three kinds of dragons hypothesised by the brilliant Cerebron – "the mythical, the chimera, and the purely hypothetical", all "nonexistent, but each nonexisted in an entirely different way." The "True Believers'" faith in the theory borders on the Religious, and needs to return to scientific skepticism. Krauss called it "the least successful great idea in twentieth-century physics." Its TOE "Equation of the Universe" a reminder of Feynman's amusing U (unworldliness)=0 summary of our laws. Glashow compared it to the ill-fated "Star Wars" program.



To be fair, the concept itself was simple and enticing – a souped up version of the Pythagorean dream, the world being the music of strings. In developing the model, however, the devil was in the details, and the cornucopia of solutions it led to (String theory could be made to fit any observable result) made it a good post-diction tool, with no predictive capability. To date, the fundamental physical principle of String Theory (like, say, the equivalence principle for Relativity, or local gauge invariance for quantum field theories) is still unknown. Kaku, who styles himself as “co-discoveror” (should I say co-inventor?) of String Field Theory, says “the theory itself seems like a confused jumble of folklore, random rules of thumb, and intuitions.... Superstring theory has been evolving backward for the past 30 years... the fundamental physical and geometrical principles that lie at the foundation of superstring theory are still unknown.” The only reason it has claimed status as a Theory of Everything is that its methodology brings out a spin-2 particle identified with the graviton, which “might” allow it to describe gravity along with particle physics.

David Gross, a key String Theory player and convert, says: “we do not know what string theory really is. When we say “The theory leads to ...”, we do not really know what we are talking about. We have many, often totally different, ways of describing approximate solutions to string theory; but what is string theory? We do not know the basic formulation of the “theory”, to which all of these different dual descriptions are approximate. I am beginning to wonder whether we may be coming to the conclusion that string theory is inherently incomplete. Originally, many of us believed that string theory represented a very dramatic break with our previous notions of quantum field theory. That was good. We probably needed something that was a serious break with quantum field theory (QFT) to solve problems of quantum gravity, cosmological singularities, etc. But now we have learned that string theory is not that much of a break with QFT. In fact, our best definitions of string theory are QFTs. Maybe, as Seiberg and Maldacena remarked, any QFT is equivalent to a dual description of some kind of string theory. Also, the fact that we have so many different pictures of string theory, perhaps even different theories – we are not sure that they are truly all connected in a dynamical sense – might be a hint that string theory is a “framework” and not a theory, much as quantum field theory is a framework in which other principles (such as symmetry principles or renormalizability) must be appended to arrive at a theory. Maybe something is truly missing in our understanding of string

theory, which we cannot identify?” “I have the feeling that the cosmological constant and all the baggage that goes along with it, such as the landscapes, might be a problem of the same nature as radioactivity was in 1911, and that we are missing perhaps something as profound as they were back then.” Such a Mea-Culpa from a prominent string leader deserves quotation in full, as it succinctly summarizes the status of this immense effort.

Michio Kaku was more specific:

- Millions of conformal String field theories have been discovered, with no way to classify them and determine which is a possible “real” solution.
- String Phenomenology suffers from a fatal defect: the theory shows Supersymmetry is unbroken, while in our real world it is broken.
- 10-dimensional space in the theory is stable, while the sales pitch was that it wasn’t, and that it was supposed to break down to 4 dimensions.
- Conformal String Field theories are unstable at the Planck Energy level, exactly the point where they are supposed to resolve the conflict between QM and Relativity!
- The fundamental problem facing string theory at present is our inability to select its true vacuum nonperturbatively. Until the true string vacuum can be discovered, it is impossible to determine whether the theory predicts nonsense, and must be discarded as yet another failed attempt at a unified field theory...

And Michio says this in a “positive” vain, as a true believer.

String Theory’s recent foray into “Landscapes” may prove to be its undoing. That foray announces in principle that String Theory is no longer seeking a Unique theory of Everything, and also will not be providing any predictions. The best it can do is to show that our World (our Unique Testable Sample of One) is one of its possible Landscape options. But given that our world has broken Super-symmetry, a non-zero cosmological constant, and other observable features that run in principle against the rules of the Landscape, then (unless String theorists pull another rabbit out of their magic hat) this would falsify the theory. The Anthropic argument, our existence, would be the proof. If the Landscape option was supposed to “immunize” String theory against all possible scenarios, that vaccine may prove to be a killer itself.

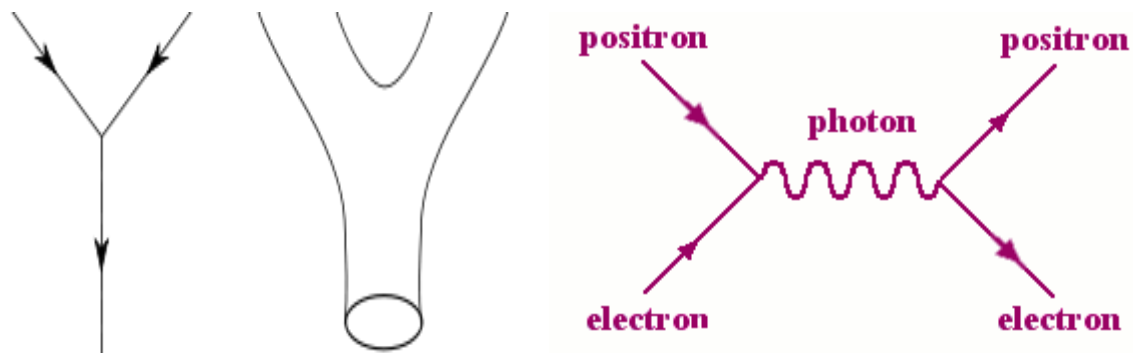
What this may prove is that it may not be possible to formulate a single theory to describe all of nature, or that our epistemology is inadequate for the task still, as Quantum theory has shown in trying to describe new quantum phenomena in classical language and concepts, or as Feynman says, “the way we have to describe Nature is generally incomprehensible to us.” Or it could be that contingency rules, and we are the result of many “accidents” without a coherent single unifying idea – the world is unique only because of those “accidental choices”, not because God “did not have a choice”. To discover those choices, isolated theoretical analysis would not be sufficient, and the guiding hand of the experimentalist is needed – and this is the area that String theory has failed to make use of.

On the other hand, the fact that much of the world’s intellectual power (including the truly formidable Edward Witten) has been focused on it for the last thirty years was a mixed blessing: many areas of mathematics and physics have benefited indirectly from this onslaught, but at the same time other avenues of research were starved (see Smolin’s “The Trouble with Physics”). Perhaps at least one can use much of these newly developed ideas to get started on new paths. After all, Supersymmetry, the core of Super-String theory, is a more universal concept that applies outside String theory as well, proposing a symmetry relation between bosons (interaction quanta) and fermions (matter particles), encompassing Poincare space-time invariance and the gauge symmetries of quantum field theory.

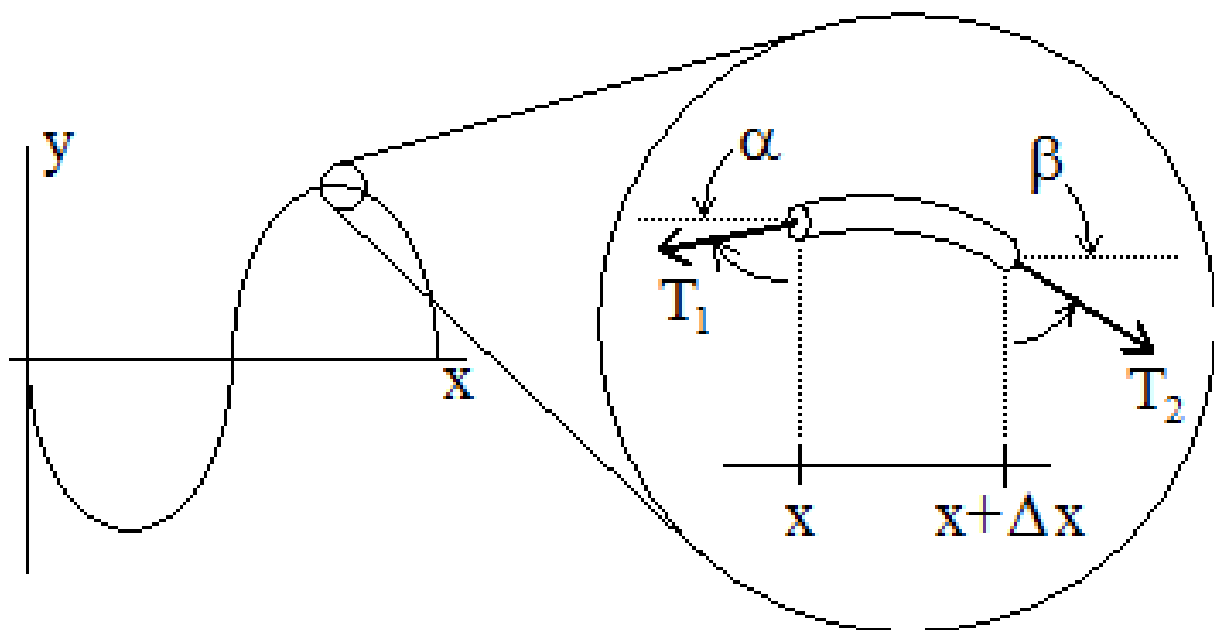
A PL-Pressure model would simulate a String in many way, while providing the grainier model which supports the Pilot PLs pictures necessary to explain such Quantum peculiarities as “non-locality” and Entanglement. The fact that string theory is local and background dependent in a fixed pre-existing flat space is one of its disadvantages (and conflicts with GR) which the PL picture overcomes, while simultaneously clarifying the emergence of space-time, a-la Loop Quantum Gravity scenarios.

Looking at worldlines of particles in collisions is just as easily visualized with our PL picture as with String theory. The Particle’s whirling PLs resemble the strings as they merge, and more naturally explain how they would physically merge into one whirlpool... The “Virtual Photon” of QM, which then splits again into “new” particles – The merged PL loops retaining a memory of their former correlation.

In String theory, “unwrapped” strings yield the zero-mass photon, graviton, and the other “massless” or “near massless” particles. These are our “Free” PL formations moving at the speed of light- in the case of photons, swinging (vibrating?) between the E & M dimensions; in the case of Neutrinos, also swinging but with insufficient pressure to cause an EM effect. “Wrapped” strings produce our massy particles- the “wrapped” photons being their equivalent, the wrapped formation slowing the forward motion, simulating “mass” and inertia.



PL Photons are the un-wrapped (Free) “strings”, with their fixed length (macro sized, not short strings, although the M-Theory radius inversion rules could make this equivalence) moving at the speed of light. The wrapped Photons are the wrapped strings, aka particles, with the number of wraps leading to mass, charge and spin properties. The “PL Pressure” is the “String” Tension.



Looking at the Mersenne law for an oscillating string, we get:

$$f = \frac{v}{2L} = \frac{1}{2L} \sqrt{\frac{T}{\mu}}$$

Where the speed of propagation of the wave on the string is:

$$v = \sqrt{\frac{T}{\mu}},$$

T being the tension, and μ its linear density, L being the vibrating length of the string. The photon, being an open string vibration moving at the fixed speed of light, would mean that $T=\mu$, or that the “density” of the string is proportional to the tension. Reverting to our usual conventions, for a string with energy $E=hv$, we had calculated an energy per nugget (single wavelength) of $E/N=$, which we’ll call the Energy per nugget, E_n .

$$E_n = h/k \cdot l_w^{**2}$$

The linear density of this energy, E_n/l_w , would therefore be

$$\text{Linear Energy Density} = (h/k \cdot l_w^{**2})/l_w = h/k \cdot l_w^{**3} = E/k \cdot l_w^{**2} = E \cdot v^{**2}/k$$

Or:
$$LED = E^3/k \cdot h^{**2},$$

proportional to the cube of the overall energy of the photon. If we take the LED to be equivalent to μ , this would mean the “Tension” in the vibrating string is proportional to the E^{**3} of the string. This would imply in our PL picture that the overall “Energy” of the photon exerts a “Tension” proportional to the cube of the Energy on the space carrying the photon, resulting in the oscillating characteristics we heuristically calculated earlier.

We have the potential to use the mathematical library of String theory on a different substrate, which may lead to simplification based on the new concept, that might limit the endless cornucopia of String Theory to make it fit our reality and focus it on a single model. Maybe then String Theory can stop being just a “Promising Theory”, as one advocate unwittingly quipped.

The PL Pressure model provides a way of easily visualizing QED, String theory, and QM, without contradicting their established principles and results, with no strings attached.

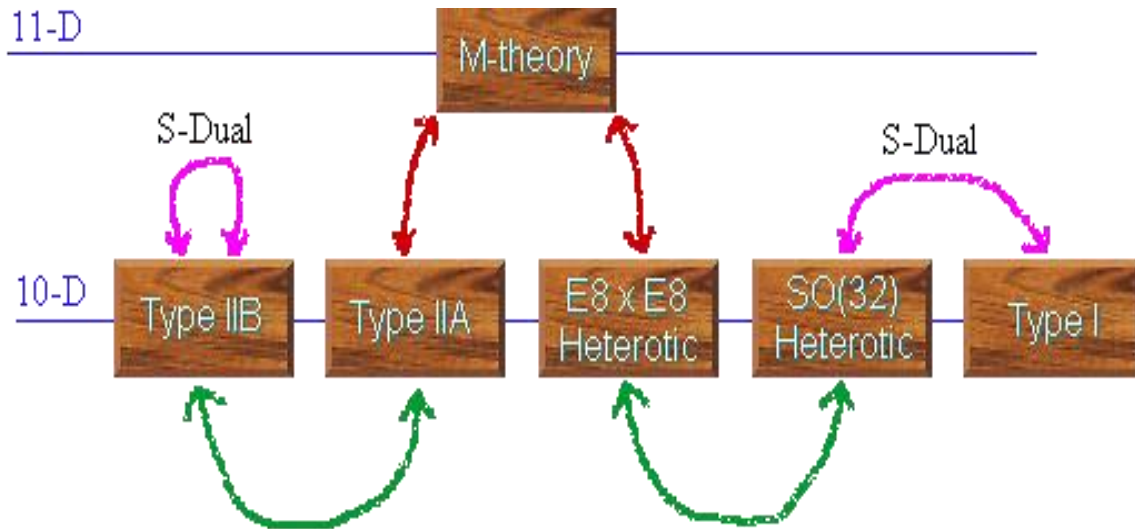
SuperString Theory: “A collection of ideas for extending the laws of physics. It has inspired brilliant work by brilliant people, resulting in important applications to pure mathematics. At present, superstring theory does not provide equations that describe concrete phenomena in the natural world.” – Frank Wilczek

“These theories are still visions upon the horizon of the great sea of ignorance, and not yet firmly linked to the connected islands of the Standard Model”. - Marburger

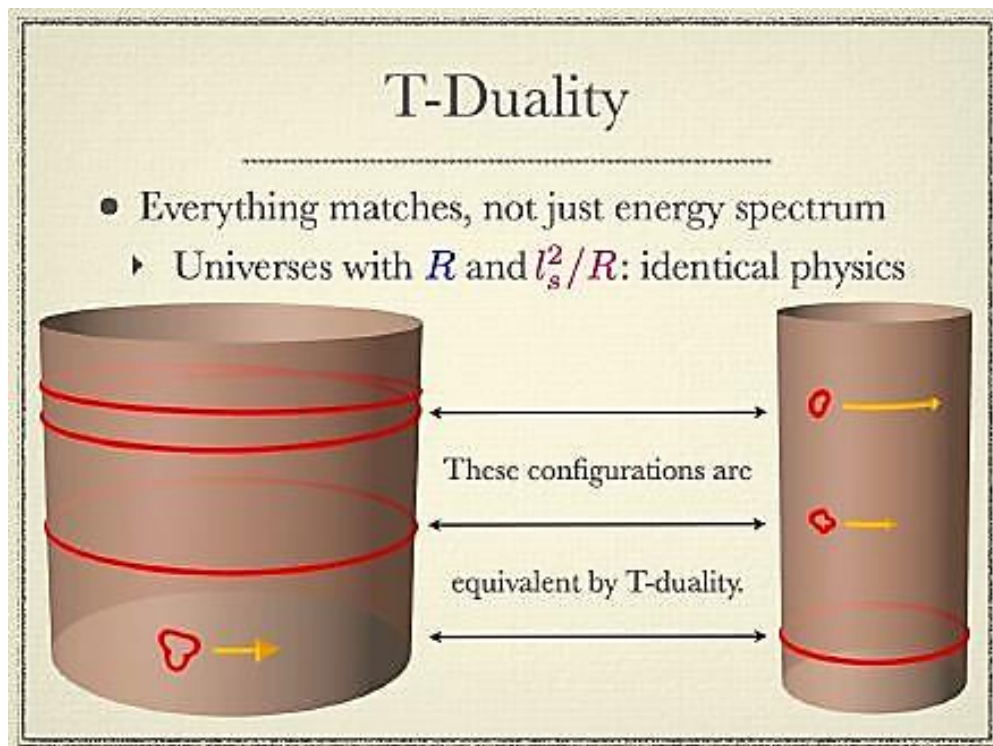


5.5.1 - DUALITY

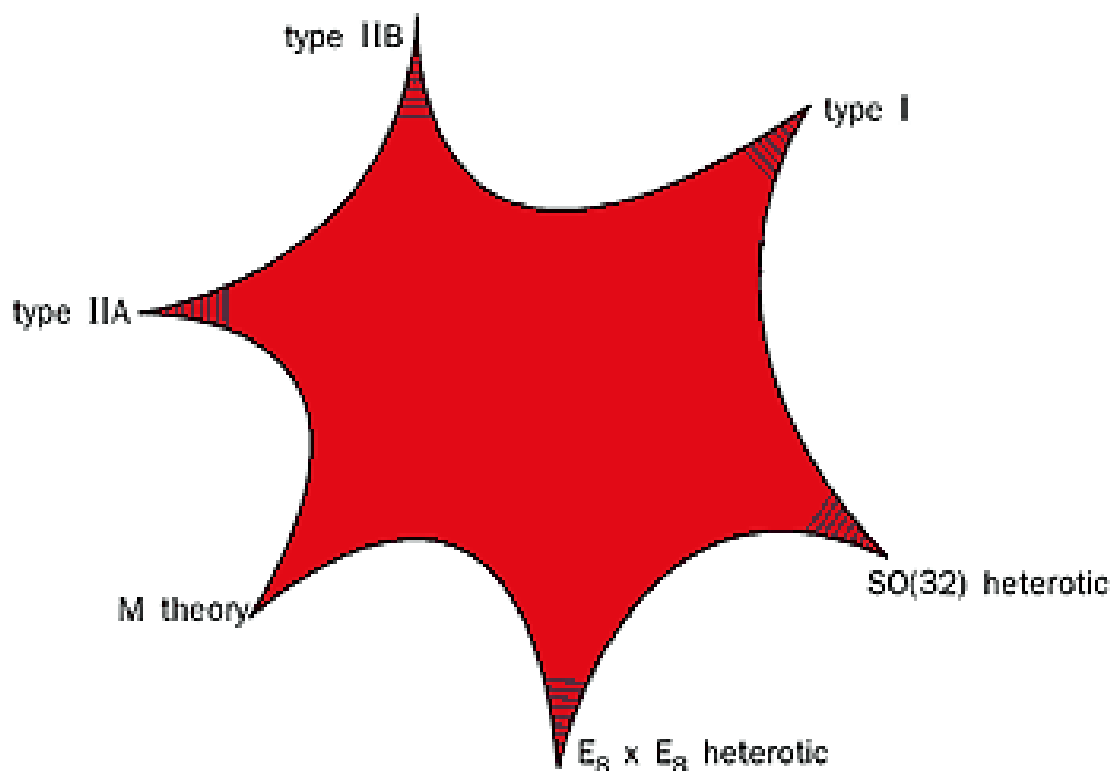
A major source of excitement in the field of String theory has been the discovery of “Dualities”, which inaugurated the second Super-String Revolution in the nineties.



The initial excitement was about dualities between the menagerie of String Theory versions themselves, an inside job. The various theories seem to map to each other under various conditions.



As Wigner and Feynman thought, there are many ways to skin Schroedinger's maligned cat. Many different mathematical frameworks can be used to pose a question, and most usually lead to similar results – united by the physical nature of the reality underneath. The Casimir effect is one such example, which can be described by classical EM interactions between local electrostatic dipoles (relativistic van der Waal forces, or Schwinger's source theory), vacuum quantum fluctuations, or by a hybrid view of the EM force as a vacuum projection. The Correspondence Principle (Sommerfeld's "Magic Wand") was a key guide in the development of QM, with classical solutions approximating QM solutions always available. Quantum Mechanics has wave, matrix, and Dirac formulations, all equivalent, each providing a window of understanding on Nature, while her actual workings remain shielded. Schroedinger mused, on contemplating the differences and similarities of Matrix and Wave mechanics: "it is very strange that these two new theories agree with one another with regard to the known facts even where they differ from the old quantum theory... That is really remarkable, because starting points, presentations, methods, and in fact the whole mathematical apparatus, seem fundamentally different. Above all, however, the departure from classical mechanics in the two theories seems to occur in diametrically opposite directions."

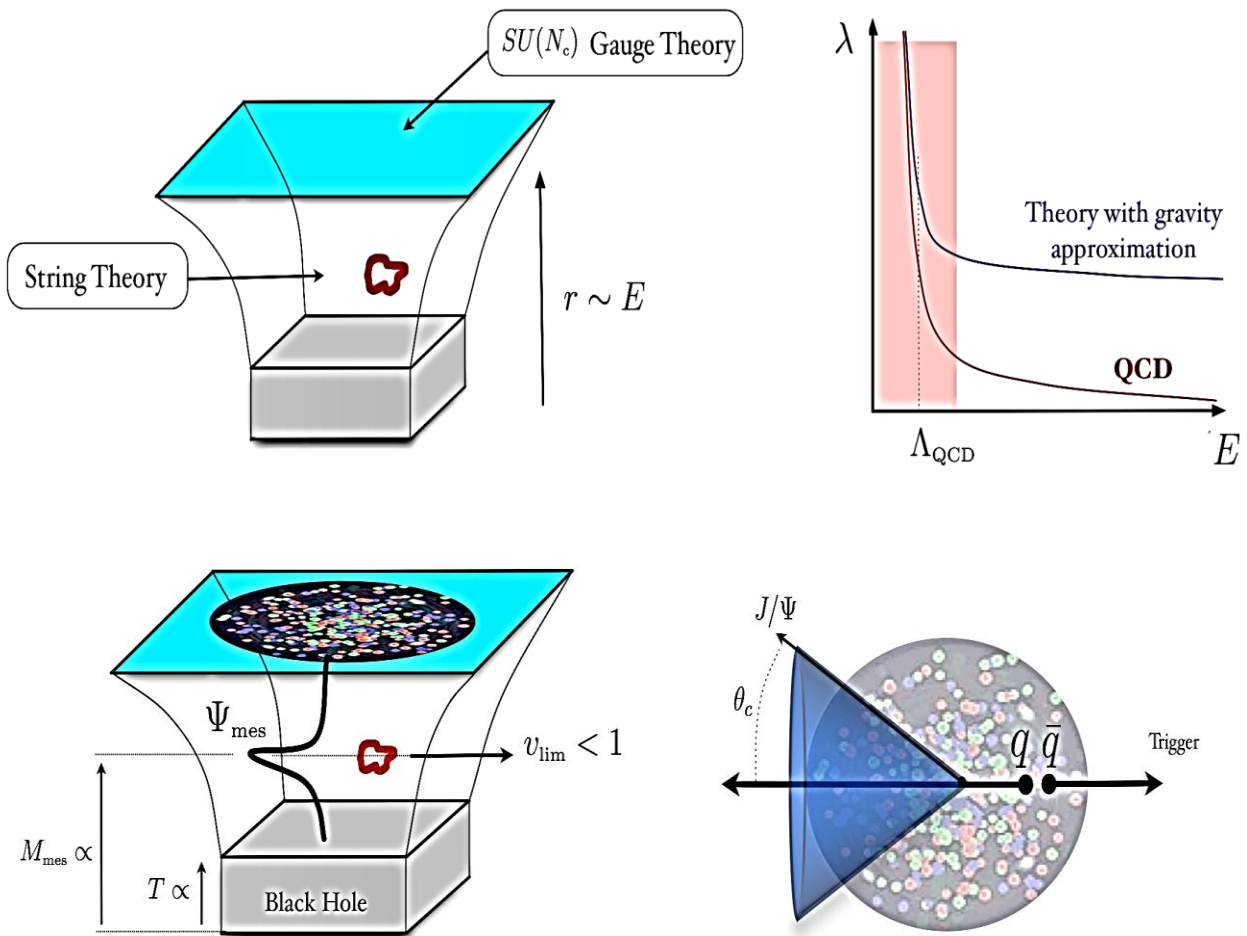


The most interesting duality, proposed by Juan Maldacena and extended by Witten and others, mapped string theory to the gauge theories of the Standard Model, via a “Fifth” dimension where mass/energy lives, providing an equivalence between gravity in five dimensions and gauge theory in four. This Holographic principle is a close analogy of our proposal for a PL world. An energy dimension is added to provide five natural coordinates, 3 space, one time, and one energy (which last could be a “complex” union of other mathematically possible dimensions), also providing a unifying framework for the known “forces” at Tera ev energies.

As it is, the hydrodynamic model of PL pressure is a close parallel of Strings, vibration mapping to hydraulic oscillations of the PL fluid. A resonant photon loop for an electron is not far from a looped string vibrating. The Ehrenfest paradox of a rotating light-speed wave also leads to a “zero” (point like) radius electron, similar to the Planck size electron string.

The Gauge- String Duality sees our Four Dimensional experience (3 space +time) as a shadow of a five-dimensional reality, carrying the same information content and identical physics. It sees Black Hole Horizons and Quark-Gluon Plasmas (QGP) as separated from our 4-dimensional world by a “distance” in the fifth dimension related to temperature/energy. Not unlike our PL Cluster peaks protruding into the “mass” dimension. It relates QGP to black hole horizons in a fifth dimension, similar to our “First Singularity” concept that created the initial dense PLC. This dimension is not rolled up, but it is not a “dimension” in the usual “length” way- we can’t “move” into it. It simply relates to a numerical measure of the Energy (or Mass, our PL density), resulting in a “curved” space-time that encodes in its geometry what we measure as “temperature”, “energy”, “viscosity”, etc...

The duality also sees a parallel between gravitational systems and this QGP soup observed in heavy-ion collisions, with a similar need for a “fifth dimension” of mass to visualize it. This ties us back to the fact that all of these aspects are related to geometrical considerations depending on the PLC cluster configurations in Hilbert Space, with different dimensional aspects being reflected in different “physical” appearances. The QGP soup is a dense PLC cluster in unstable formation, its various attempts at forming structures representing the “virtual” gluons and quarks that appear in the process. Each one of those nucleons is a particular structure in the 5-dimensional picture.



By the way, this “Fifth” Dimension could be a stand-in for the other extra dimensions. Even String theorists admit the possibility the various extra dimensions could be mathematical (read Hilbert Space) conventions that map physically into this Fifth dimension of reality. As Steven Gudser says: “I’m not convinced that the extra dimensions of string theory as a theory of everything will be more tangible than the fifth dimension of the gauge/string duality.” The various dualities allow a flexibility in the theoretical mathematical constructions that are not necessarily fundamental, but simply mathematical “languages” we can use to describe the same aspects of reality depending on the situation and fit. Shades of Bohr’s complementarity abound.

So here is the upshot of the above:

- Strings and their vibration modes are similar conceptually to a hydrodynamic PL fluid model in oscillation.

- The various String Theories map into each other, essentially providing mathematical tools to explain the various phenomena as perturbations and oscillations in additional dimensions
- The Gauge/String Duality maps all of these extra dimensional concepts into a single “Fifth Dimension” of energy that is apparent in our own 4-dimensional space-time, as described by our visualization of PLCs as warps in the space-time.

So gluons can act like “QCD” strings. Photons are PLC clusters in an “Electric field” (PLs oscillating in the EM dimensions of the Hilbert Space). Quarks can be seen as PLC Clusters in a “Chromo-electric” field (PLs oscillating in the EM and Color dimensions). The “Virtual Particles” are oscillations in the main PLC of the core particle, as its “waves” propagate from it, and those waves in the field tell other particles how to move in response to them – Force! Different alignments of this wave propagation give different effects – QCD strings (alternatively virtual gluon clouds) providing collimated Strong Force interactions, Photons producing EM forces, etc. The Dynamics of such “Strings” or Virtual Gluons were studied well before QCD or String Theory formulated their version of describing the action, as part of understanding Meson structures and nuclear binding. A Theory that can emulate these Gluon/String structures will mesh in perfectly with the accumulated science and observations that have been described using those formulations.

An interesting aside on Duality is the indistinguishability in String theory of compactification on a circle of radius R from compactification on a circle of radius $1/R$. This points to a breakdown of classical geometry at the sub-planck scale, and provides a link to the Heisenberg uncertainty principle. It may also explain some aspects of non-locality, where a large distance may not seem so large in its dual interpretation.



$$R \leftrightarrow \frac{\alpha'}{R}, \quad n \leftrightarrow 10$$

The “Conformal Invariance” symmetry in String theory equates the Physics of two close strings with their Physics if further stretched apart, another clue perhaps to “non-local” behavior.

The CFT/ADS Duality, Maldacena’s insight, sees a duality between weakly coupled string theories and strongly coupled four-dimensional QCD-type theories, mapping 10-dimensional Type IIB string theory to 4-dimensional superconformal gauge theory. Similarly, 10-dimensional supergravity theory in anti-de Sitter space maps to a 4-dimensional superconformal Yang-Mills theory, itself a “holograph” of a 5-dimensional anti-de Sitter space. Smolin used octonions to explain why space can look three-dimensional while being, in a mathematical sense, nine-dimensional. Witten has proposed Twistor String Theory, as a way to do String theory in 3+1 Minkowski Space-Time. One recalls Feynman’s view that almost all grand ideas have multiple, equivalent solutions, with the mathematical venues branching about to reach “equivalent” explanations of Nature’s ways. Unfortunately, as Brian Greene puts it, “the mathematics of string theory is so complicated that, to date, no one even knows the exact solutions of the theory. In stead, physicists know only approximations to these equations, and even the approximate equations are so complicated that they as yet have been only partially solved.” While Hertz thought many of our equations are “more intelligent than the person who invented them”, String theory equations must be a lot smarter than their inventors. As one wag quipped, tired of hearing about the “beautiful equations” of String theory, “where are the art critics of Science?”

The House of String Theory may turn out ultimately to be a house of cards, the truth being “out there” elsewhere, but the effort is not in vain. Like many fruitful ideas, even if it fails experimentally, it is not a waste- having spawned many alternate ideas and entire mathematical disciplines.

Even Ed Witten is ready to accept Strings may not be fundamental, but emergent from something more fundamental (perhaps a PL Pressure model? ☺). Still, the concepts involved and the mathematical insights (which are no longer “too beautiful not to be True”) can be, and have been, used to clarify

other ideas, displaying Nature's game that it plays with similar rules in many places. The search for a Unified Theory is a noble one, and it occupied Einstein in his latter years (to the derision of the Physics world, who now celebrate every String Theory non-discovery). And Einstein did it without monopolizing 80% of the US Scientific budget, which should be dispersed into other, perhaps more fruitful ideas. It is time to break the Herd mentality, and let a thousand flowers bloom.

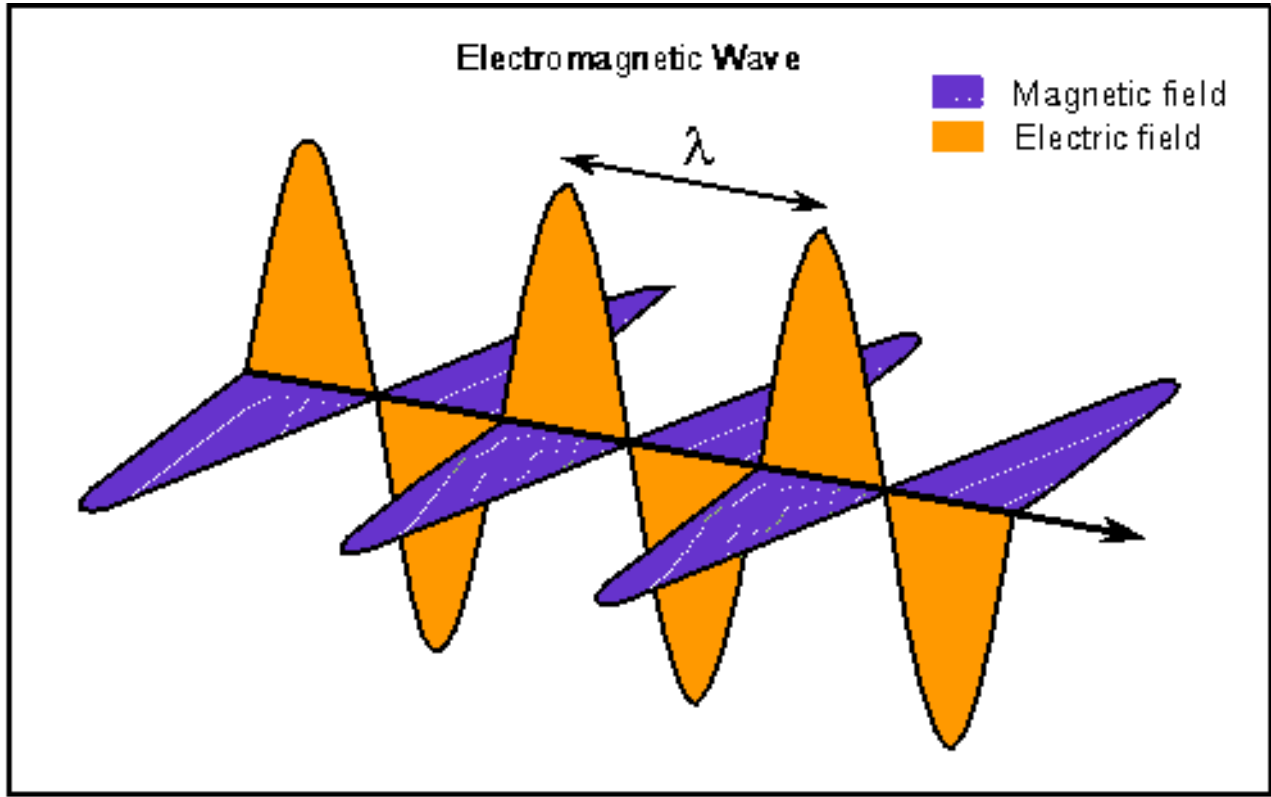
"The extent to which people can invent imaginary worlds when science gets decoupled from experiment is quite extraordinary. They follow a certain aesthetic of mathematical elegance out there as far as it takes them." – Lee Smolin

"The promise of string theory, a tantalizing, immensely difficult not-quite-theory, is likely to remain a promise well into the present century". Marbgurger

"There may not be any observable predictions of string theory that cannot also be predicted from general relativity or supergravity. If this is true, it raises the question of whether string theory is a genuine scientific theory. Is mathematical beauty and completeness enough in the absence of distinctive observationally tested predictions? Not that string theory in its present form is either beautiful or complete. ... So far, its performance has been pretty pathetic: string theory cannot even describe the structure of the Sun, let alone black holes." – Steven Hawking

Takeaway: String theory has not yet produced a valid model to mimic reality. However, its many ideas, including duality, provide parallels to our PL model. A Photon PLC can mimic an open string. The many dimensions are the home of our various types of photons & colors.

5.6 - ELECTRIC AND MAGNETIC COMPONENTS

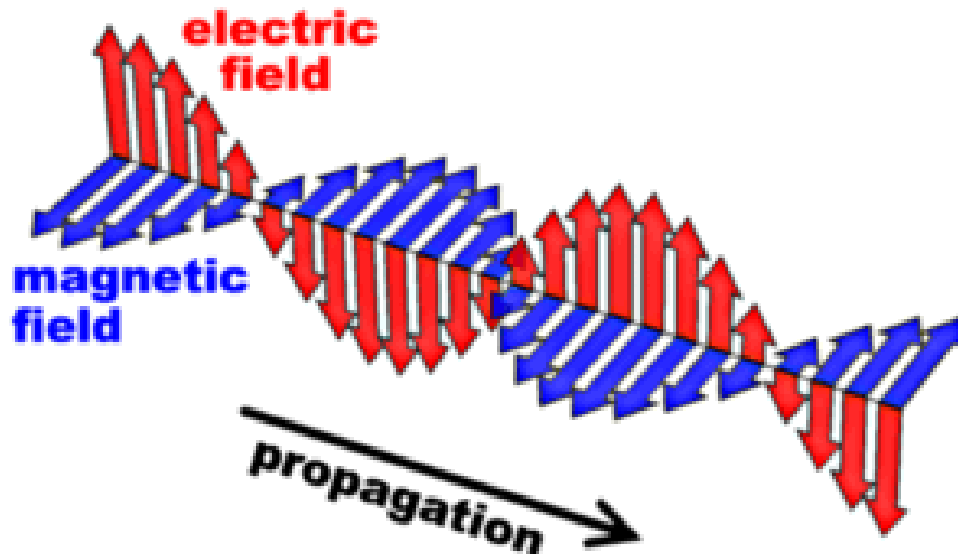


A Photon, in our classic sense being a manifestation of the electromagnetic field, seems to have two components: electric and magnetic, orthogonal to each other. How does this come about in a PL world?

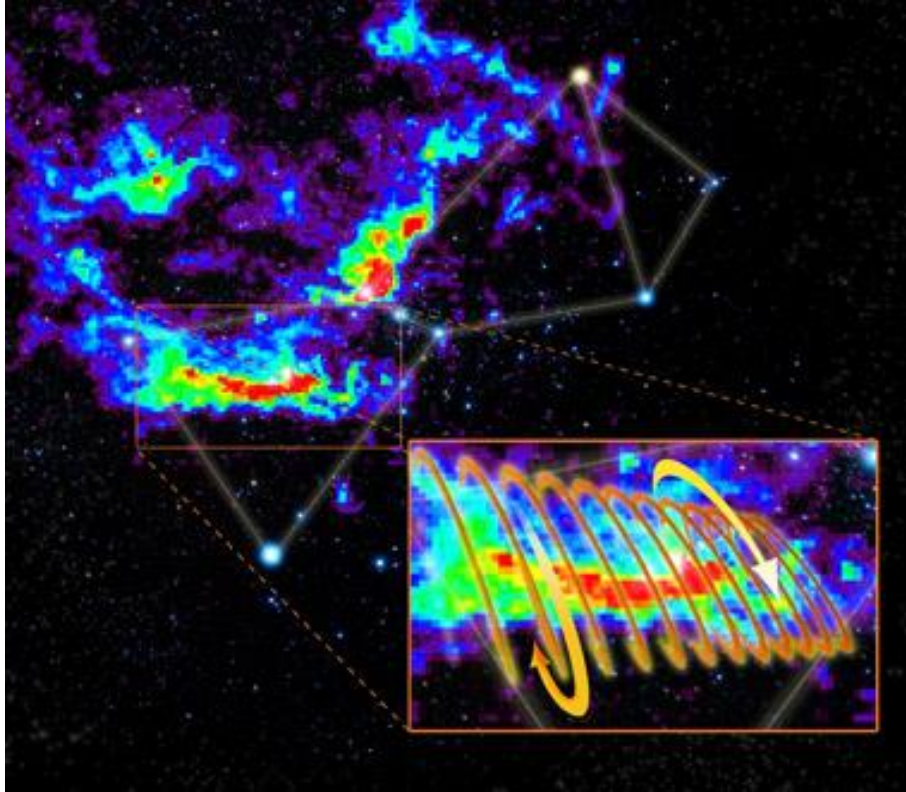
- We have to think of the Electric field and the Magnetic Field as different manifestations of the PL field, as “separate” Dimensions in the PL Hilbert space of existence, whose magnitude is the PL number, but which can take two orthogonal directions in that multi-dimensional space, one of them we “perceive” as magnetism, the other as electricity.
- Normal Universal Vacuum does not manifest this property to us because of its very low amplitude and uniformity, forming the “base” from which we measure. Its “PL Pressure” is too low to start the Light-wave cycle of electromagnetism.
- When the PL density is high enough to form Photon packets, the oscillations start at a frequency proportional to the PL density (“Energy”), and this oscillation happens in both “Dimensions” of Electric and Magnetic space, detected in our world as the electric and magnetic components, orthogonal to each other, being in different dimensions of

the existence space. Since the two dimensions oscillate synchronously with the PL density, their amplitudes measure the total “Energy” of the photon. As Einstein thought, Light can exist only when it is moving forward, at its own speed – Light is by definition the PLC packets moving forward at light speed.

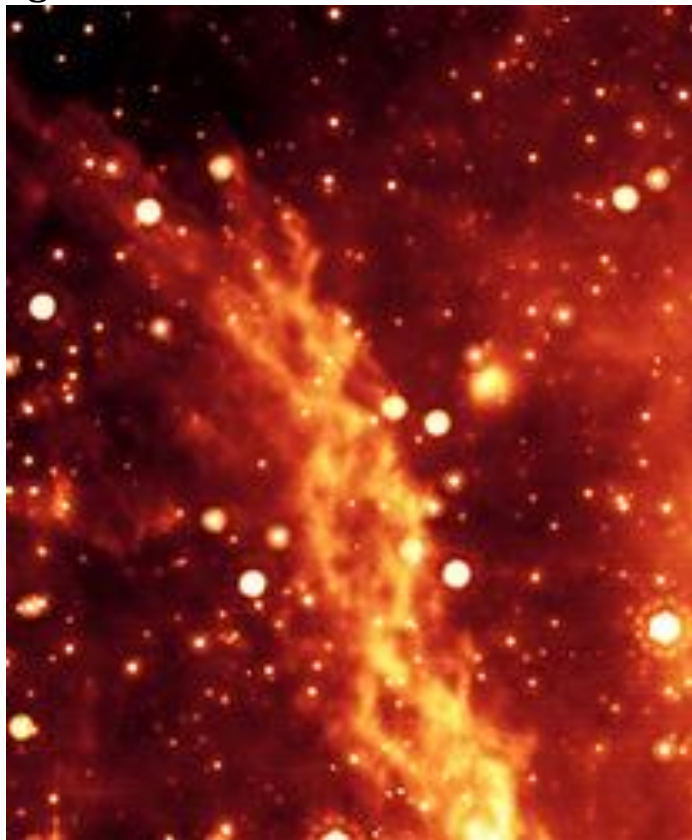
- What Maxwell called the “mutual embrace” of electricity and magnetism, is a manifestation of the sinusoidal back and forth drift of a constant PL density between the “electric” dimension to the “magnetic” dimension, leapfrogging each other in small fast jumps between the two dimensions (or one circular dimension). As the density in one dimension grows, it starts driving the PLs back into the other dimension, while moving “forward” between “space” nodes at the “speed of light”.



- So what is a photon? A photon is a time-limited set of cycles of this electromagnetic wave. It seems the wave gets packaged every X (a very small number) seconds into a coherent set. This package we call a photon, and define its energy as $E = h\nu = hc/\lambda$, where λ is the wavelength of the oscillation. Since every wavelength contains a fixed nugget of PLs, the energy of the photon is a multiple of the number of nuggets that are contained in the package, and that number is related to the frequency.
- An interesting example of Nature repeating its tricks at all scales: Helical Electromagnetic storms in distant Nebulae:



Large magnetic helix found in the Orion Molecular Cloud



Double helix nebulae at the center of the Milky Way Galaxy

5.7 - DIMENSIONS

“There is a dimension, beyond that which is known to man. It is a dimension as vast as space and as timeless as infinity. It is the middle ground between light and shadows, between science and superstition, and it lies between the pit of man’s fears and the summit of his knowledge. This is the dimension of the Imagination.”

– Rod Serling, *The Twilight Zone*

So how many dimensions are there? Or as Feynman used to poke String theorist John Schwartz, “how many dimensions are you in today?”

Well, in an emergent world, the emanent properties that are not correlated to more basic properties reflect our perception of a new dimension.

Dimensionality (read: degrees of Freedom) would be an emergent feature of our world, and not an intrinsic property. It is in the eye-of-the beholder, the observer, and not in the data – like a CD of a Video, whose final dimensionality depends on how it is played and the “instrumentation” used to view it.

Space we perceive as a 3 dimensional orthogonal set of directions in the Hilbert space. That is an artifact of the “stability” of that configuration, 3 dimensions being the only one resulting in a stable “gravitational” and “Electromagnetic” environment, as Ehrenfest originally proved. In a string scenario, Brandenberger and Vafa could also explain the emergence of 3 dimensions from M-Theory’s 11 dimensions (string – anti-string collisions frequent until a 3-dimensional highway opens up ☺). Since that is the stable configuration, and we were “configured” in that arrangement, our senses are developed to see it that way. We don’t “feel” the vacuum of this 3 dimensional space, since it is the substratum of our existence, the “ground” we walk on, so to speak. For we, made out of matter/energy, live elsewhere, in the 4th/5th dimension.

Each dense point in that space has an Electric field and a Magnetic field. Even though correlated in magnitude and direction, they exhibit different effects through their orthogonality (in their joint circular dimension, hence their inter-convertibility to observers in different states of motion). (Feynman, Leighton and Sands (1964) had shown that magnetic force can be mathematically expressed in terms of the effect of a moving electrical potential field on a charged particle, without the need for any magnetic potential field terms). They form two tightly bound dimensions, flip sides of

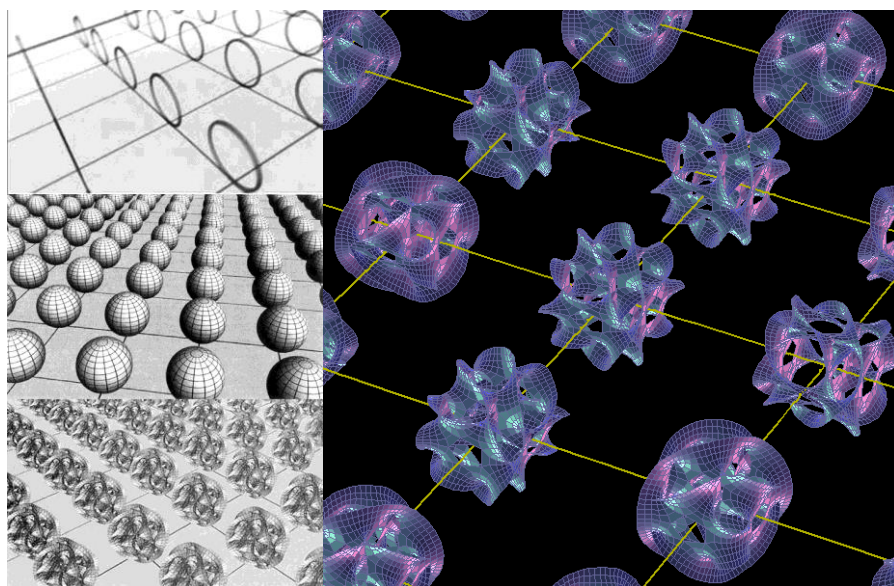
the same coin, providing a “measure of existence”, the matter and Energy we “feel” and of which we ourselves are made. Since they represent the actual existence, the “Energy” of the photon can be seen as a combination of two additional dimensions in the Hilbert space. We, being matter and energy, are in those dimensions as well, our feet planted in the other 3 space dimensions.

So when we talk mathematically about 4th and fifth dimensions, we always say we have a hard time visualizing it. Well – we “visualize it” all the time, every minute of every day... we just see it as “matter” or “energy”, which are essentially those additional dimensions of “space” otherwise named. We actually normally see them as one thing (effectively one extra “dimension” since the two correlated sub-dimensions (Electric and Magnetic) are “felt” by us through their net “energy” or “mass” (scalar mappings of those dimensions on the 3-dimensional space) impact, seen as one). Those “additional” dimensions leave an observable imprint on our extended three dimensions via their moduli fields and the radii of their dimension. We cannot “see” the fifth dimension, but its ripples appear to us as Light!



To define where something is in our usual “three dimensional space- plus time”, we specify x,y,z coordinates and the time. That uniquely specifies where/when something is. But push the envelope a bit, and think of the PL density as an emanation in another dimension, So to specify where a point is, you also have to give its PL density... its position in that additional dimension. A warp in space can also be seen as an additional dimension.

It is a difficult thing to visualize... Plato’s cave allegory aptly demonstrated the mystery of trying to abstract a three dimensional world from the two-dimensional shadows on a wall. Abbot re-invented the metaphor in his Flatland “romance”. A. Square wondered about the infinite possibilities such additional dimensions would make possible. Centuries later, we are only starting to crack the veil of mystery.

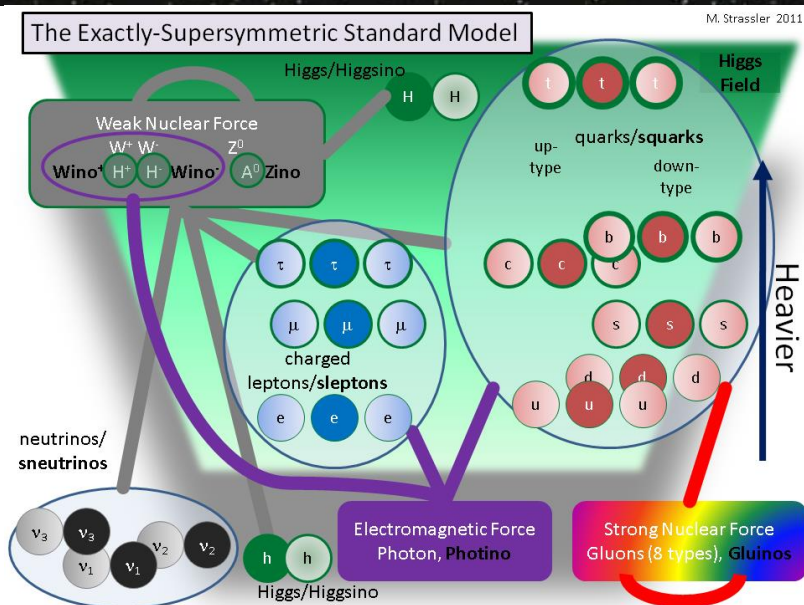
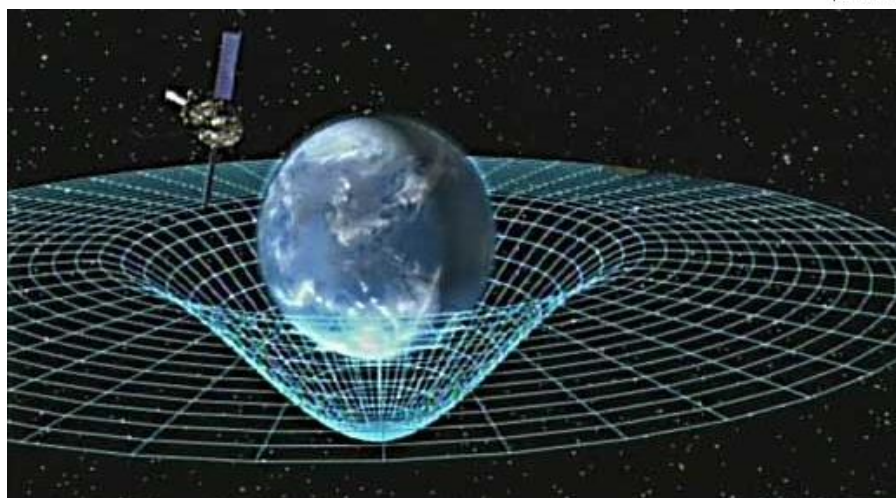
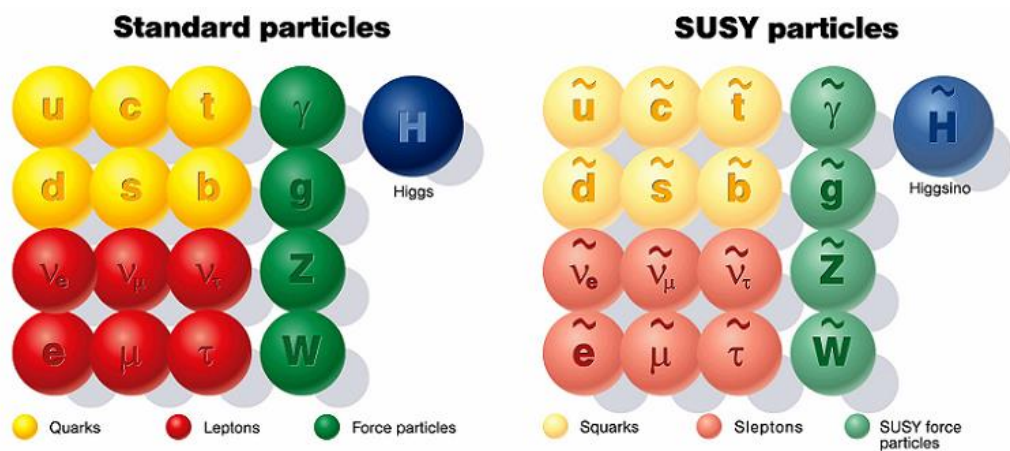


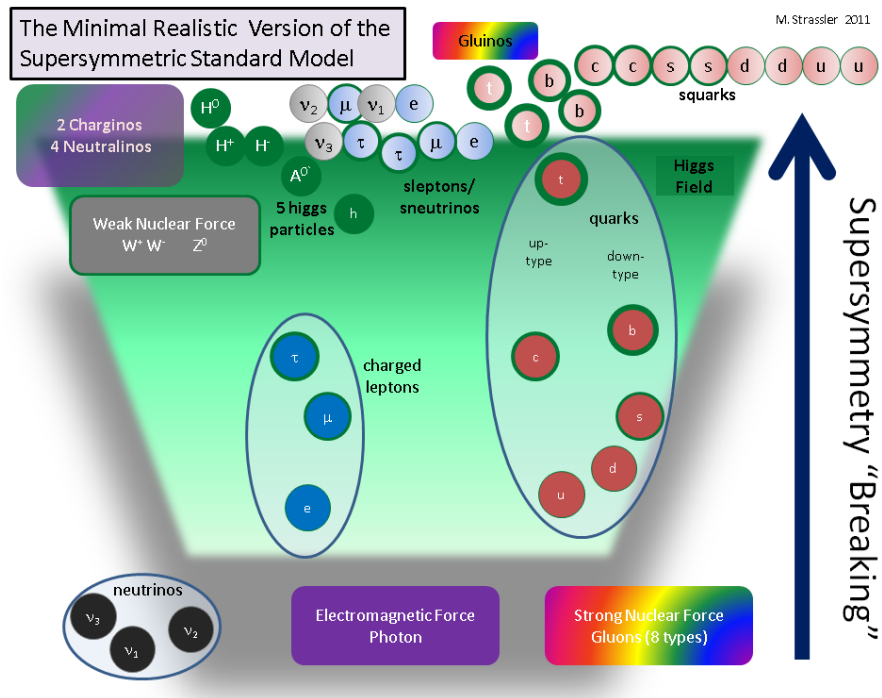
So when the PLs that form the node in space increase in number, they push into those two extra dimensions of the Electromagnetic spectrum, electrical and magnetic, their “numbers” at each point in space representing their value in the “Electromagnetic Field” dimensions they form. We “feel” them as matter instead of seeing them as space, unless, like Dark Matter and Dark Energy, they are too “small” to be felt.

The three space dimensions, in fact, are “drawn” from the travels of the PLs in those extra dimensions – Space being the emanation of relationships from Light’s travels. Since only a 3-dimensional perspective leads to stable Gravitational and electromagnetic formations, the matrix eventually stabilizes in that 3-dimensional perspective. Mass/Energy, both EM emanations, “stand” on the space matrix, in separate dimensions – the picture of a 2-dimensional space (harder to visualize as such in 3-dimensions) with mass warping it indicative of how a new dimension (in this case the vertical) arises.

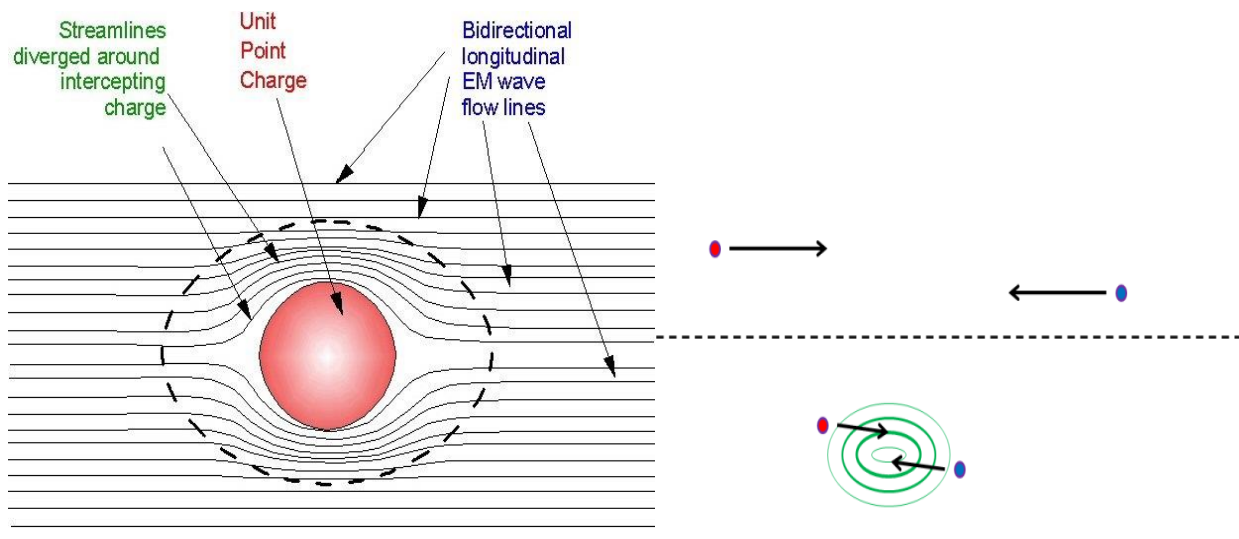
The 3-dimensional emanent world would obey Symmetry rules, symmetry being the default (non-differentiated) option. Eleven Dimensional supergravity allows gravity and supersymmetry to determine all the allowed particles, determining both force and matter. In a higher dimensional construct, Super-Symmetry (SUSY) rules may apply, with the various SU Group rules setting the stage for particular allowable configurations, out of which comes our various “particles” and “sparticles”, our photons and photinos, quarks and squarks, gluons and gluinos, gravitons and gravitinos, neutrinos and sneutrinos. Some of those particles may not EXIST – just

because the rule allows them, they may not have happened, or other conditions for their configurations may not have materialized. SUSY is a subtle lady, and if only we knew SUSY like God knows SUSY...





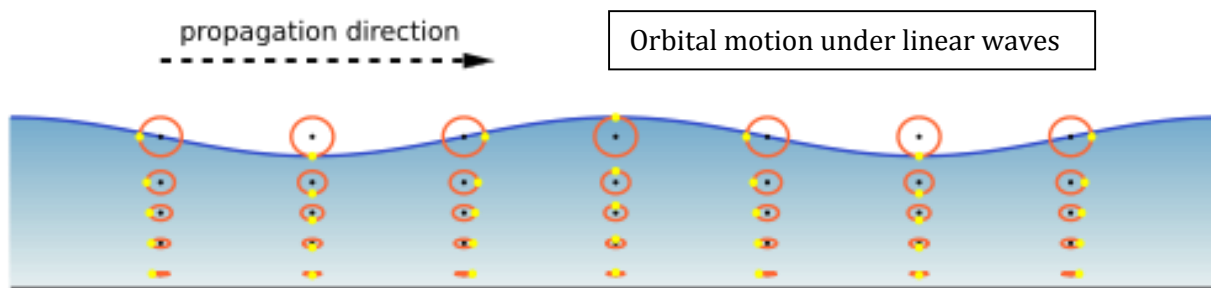
It is important to mention that SUSY predictions have still to be seen in the LHC or elsewhere, and many think it may not exist, even though many careers (and String Theory) hang in the balance. Yet, Supersymmetry itself, a kind of parallel of Relativity's "boost symmetry" extended to the additional Quantum dimensions, seems a reasonable idea for Nature to adopt. As Peter van Nieuwenhuizen says, it is "so beautiful, .., that Nature should be aware of it!"



Such a view, where our 3-dimensional world is seen as a substrate of a 5 or more dimensional world, where the other dimensions represent the "magnitude" of PL projections, could easily explain "Holographic Universe"

approaches, that see “our” 3-dimensional space world as a Holograph of a 4 dimensional space reality. Gerard ‘t Hooft’s and Leonard Susskind’s work verified this holographic concept, mapping the physics of a quantum gravitational system in $d+1$ dimensions coded holographically in d dimensions. (One hint: “Maxwell’s equations imply that the flux of the electromagnetic field through an arbitrary surface in four-dimensional space-time equals the length of the perimeter of the surface” (Marburger)). Matrix Theory versions of String theory also demonstrate the emergence of gauge theories of quantum gravity based on those “Holograms”.

In an analogue to Airy waves of a deep ocean, the “surface waves” of EM in our 3-D space could reflect a deeper surface rotational circulatory motion of the fluid’s “particles” (our PLs) in the underlying dimension.

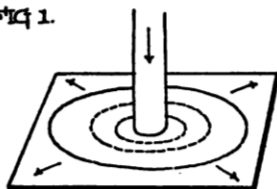


As far back as 1913, this idea of matter being an extra dimension was clear to Artists who have a knack for seeing unusual imagery. Below is Claude Fayette Bragdon's Art Deco phantasmagoria, *A Primer of Higher Space*, where he sees the extra dimension AND the wave duality!

Many had dabbled in ideas of higher dimensions, from Charles Hinton’s Tesseract to Abbot’s “Flatland” to Schofield’s “Another World”. Some did so in honest wonder, like D’Alembert, Pearson (with his Aether Squirt theory) and H.G. Wells (whose character famously said “there is no difference between time and any of the three dimensions of space except that our consciousness moves along it”); others in whimsical mystery, like Swedenborg, Fechner, Zollner, Slade and Tait (with his soul-vortex rings); yet others in artistic creativity (Marcel DuChamp and the cubists). Hinton’s suggestion that electricity and magnetism might be symptoms of an additional dimension would fit right into today’s String theory and fermion dimensions. Henry More’s “spissitude” dimension for souls would fit better in MAD magazine.

THE DENSITY OF BODIES AN INDICATION OF A PRESSURE FROM THE DIRECTION OF THE FOURTH DIMENSION AND A MEASURE OF EXTENSION IN THAT DIMENSION

FIG 1.



A STREAM OF WATER FALLING VERTICALLY UPON A PLANE SURFACE TENDS NATURALLY TO SPREAD OUT IN THE TWO DIMENSIONS OF THE PLANE, SETTING UP, IN SO DOING, UNDULATIONS IN THE SHAPE OF ENLARGING CONCENTRIC CIRCLES,

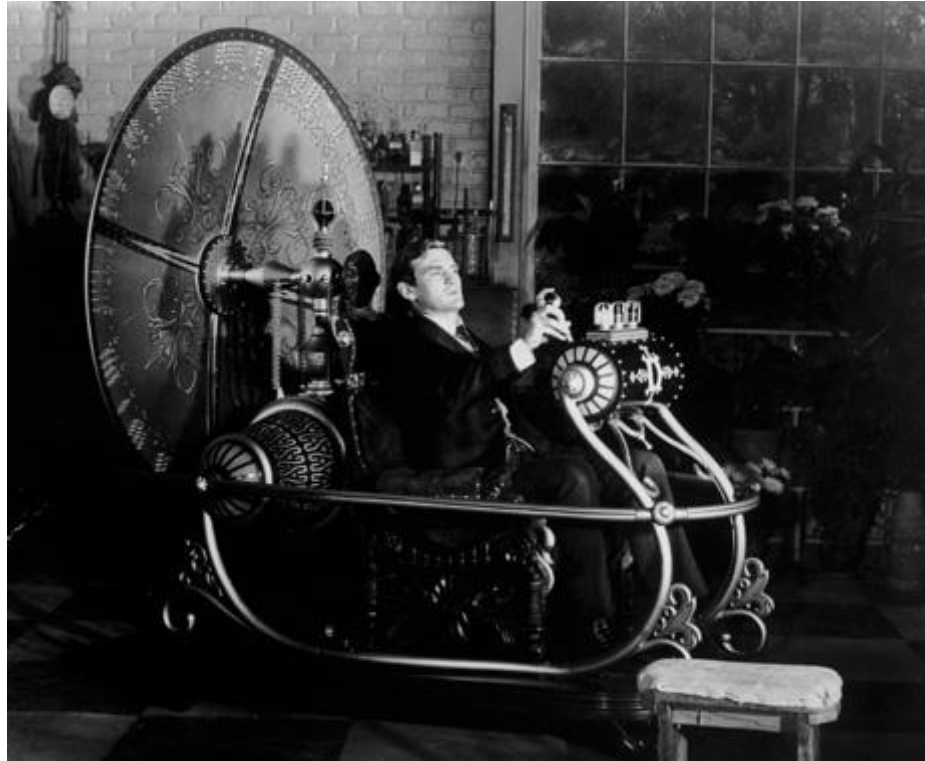
DIMINISHING AS TO DEPTH. THE RAPIDITY OF THIS LATERAL EXTENSION, AND THE FORCE AND HEIGHT OF THE WAVES WILL DEPEND UPON THE HEIGHT FROM WHICH THE STREAM OF WATER FALLS, THAT IS TO SAY UPON ITS PRESSURE IN THE THIRD, OR VERTICAL DIRECTION. [FIG 1]

CARRYING OUT THE ANALOGY, IN OUR WORLD OF THREE DIMENSIONS THE EXPANSIVE FORCE OF GASES WOULD BE DUE TO SOME SIMILAR INFLUX FROM THE REGION OF THE FOURTH DIMENSION, AND THE AMOUNT OF PRESSURE EXERTED BY A GAS WOULD BE A MEASURE OF FOUR-DIMENSIONAL EXTENSION. SO LONG AS THE QUANTITY OF ENERGY COMING DOWN FROM A HIGHER WORLD IS NOT EXPENDED, THERE WOULD BE SOME DEGREE OF FORCE ENTERING BY WAY OF THE FOURTH DIMENSION WHICH CAUSES THE GAS TO DILATE IN OUR THREE-DIMENSIONAL WORLD. THE CAPACITY OF A GAS TO EXPAND COMES THUS FROM A FOUR-DIMENSIONAL WORLD.

THE DENSITY OF SOLID BODIES WOULD BE DUE TO THE SAME CAUSE, WITH THIS DIFFERENCE, THAT THEY ARE STABLE, AND CANNOT DILATE; THAT IS TO SAY, THEY ARE IN EQUILIBRIUM WITH ATMOSPHERIC PRESSURE. AS A CONSEQUENCE, THE VARIATIONS IN THE DENSITIES OF BODIES WOULD BE DUE TO VARIATIONS IN THE FORCE EXERTED FROM THE FOURTH DIMENSION.

THE FOURTH DIMENSION CAN THUS BE CONSIDERED AS REPRESENTED BY THE DENSITY OF SOLIDS, OR BY THE EXPANSIVE FORCE OF GASES.

Meanwhile, Oupensky's view that a fourth dimension would show us our 3-dimensional world was an ephemeral optical illusion hints at holographic universe concepts, although he could not conceive it yet. Pawlowski ("Journey to the Country of Four Dimensions") thought our language (verbal and visual) was insufficient for us to understand additional dimensions. The genius Gauss was more cautious, holding back on many questions in his mind, waiting for his passing so he would have a better appreciation of four or more dimensions on the other side!



H. G. Wells “The Time Machine”

The much maligned Nordstrom’s theory of a 5 dimensional universe, with an extra spatial dimension, with the EM fields in all 4 dimensions, has us feeling the strength of the EM field in 3 dimensions and interpreting the same field in the 4th spatial dimension as gravity and the gravitational field. This theory, ignored in the shadow of mighty Einstein’s relativity theory, comes back now in minor variations of disguise in String Theory’s Gauge Dualities, where a 5th dimension corresponds to energy. It also closely parallels our proposal of all fields being PL emanations in the various dimensions. To describe a meeting point, you need to describe its 3 spatial dimensions, its time, AND its location in the fifth dimension – we just choose to call that last one the energy at that point, and insist on measuring it that way.

The Nil-Source, where the PLs “disappear” in their oscillation, can be seen as a separate dimension, an “Xth” Space dimension to which they escape, where their properties are still maintained/correlated, but disappear from our 3 dimensional world. Such is the view of the “epi-Universe” team where our “mass” comes from that “epi-Space” via “Spatial Condensation”, but the concept is the same. Those theories (advocated by Leffert and others) also look at space node creation via matter injection, in a different scenario.

The other “properties” of charge in Quarks, such as color, would be additional reflections of “dimensional” aspects of the PL world. Quarks come in three colors: Red, Green (White in US ☺), and Blue (including anti-colors analogous to positive and negative electric charges), which are also conserved properties. Quarks would be “color-photons” in the color dimension wrapped up a-la-electron, with their “color” equivalent to the electron’s electric charge. In QCD, the quark wavefunction is a vector in Color Space. The fact that quarks also have electric charge means they have a more complex rotation that takes them both into the color dimension and the electric charge dimension. These charges manifest themselves in internal dimensions of the particles, externally visible as isospin and charge in our 3D space.

Similarly, Neutrinos could have their own “charge” (possibly the “weak” charges) if their PLs move in a dimension of their own. Apparently, motion in that dimension does not interact with the other dimensions much, and hence is not easily detectable in our EM dimensions. That Neutrino dimension, by the way, could easily be a tightly wound circular dimension, justifying the “spin” aspect of neutrinos. The same could be true for the other Fermionic dimensions of EM & Color.

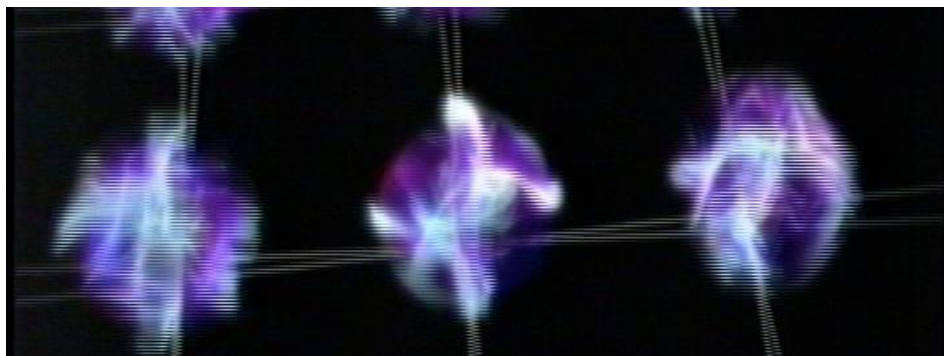
Incidentally, those extra dimensions do not necessarily have to be “compactified” as envisioned by String Theory or Kaluza-Klein. The reason we do not “see” them is because we “see” with EM radiation, which is in its own set of dimensions (and we do “see” those EM dimensions – we just call it light). Since the EM radiation does not flow into those other dimensions (Color, Neutrino), we do not “see” them, and in fact we do not get much interaction with them except for their electrical charge effects, and “mass” effects, which are in the dimensions we “see”. Since Gluons act only within Nucleons, we never had any incentive to “evolve” to “see” them. Wilczek’s QCD-Lite proposal suggests how the “colors” impart mass to the quarks and gluons, when the color mixing and distances involved are right (i.e. in the proper geometric configuration, perhaps driven by spontaneous symmetry breaking as in the Higgs Standard Model), again seeing mass resulting from energy.

So if we count off dimensions: 3 “Euclidean” (Vacuum) dimensions, one EM dimension (mapping to mass and charge, perhaps a single “circular dimension”, a-la closed string around a cylindrical dimension. The relative

view of electricity and magnetism, which depends on the observer, such that one person's electricity is another's magnetism, confirms this geometric view), 3 color dimensions (Red, White and Blue), and two weak-charge color dimensions (Green and Purple) – voila! The 9 dimensions of String theory- without strings, spring from the concepts of Gauge Symmetry and Supersymmetry – 3 ordinary space dimensions and 6 “Fermionic” dimensions – plus of course the time dimension. Here is the $SO(10)$ ten-dimensional space with its rotational symmetry, unifying the $SU(3)$ (Strong)* $SU(2)$ (weak)* $SU(1)$ (EM) symmetries of the various charges, and unifying the “forces” of Nature. Gravity, a reflection of EM, which itself is a hypercharge mixture $(-1/3 (R+W+B)+1/2(G+P))$ of the 5 other charges, is unified automatically with them.

Another hint at unification where the forces unite at high energy is M Theory's gauge/string duality and the extra dimension (making 10 space+1 time), which “opens up” in String theory at high energies- saturation in the ordinary dimensions leading to overflow to an additional unifying dimension.

In line with this String theory sees the graviton spin due to motion in the Fermionic dimensions and the ordinary dimensions of spacetime. This could reflect the fact that what I have occasionally called the “mass” dimension is a complex mapping of the values in the Fermionic dimensions. The field theories in the Superspace of those extra dimensions can be mapped to our QED and QCD gauge theories. Superstring theory employs Kaluza-Klein mechanisms to unify gravitation and gauge interactions using the higher dimensions. In these theories, the higher dimensional graviton field appears as a graviton, photon, or scalar in the 3+1 dimensional world, depending on the alignment of its spin with the infinite Euclidean dimensions or compacted dimensions (necessarily configured as specific constrained Calabi-Yau six-dimensional spaces to produce the correct 3-dimensional aspects).



Again, although we call those dimensions, which brings to mind “distances”, we are not talking cms and meters here. These are dimensions in Hilbert Space, and their values are just numbers – PL numbers in this case. You can think of “colour” also as momentum phases or directions in the Phase space, and those directions are measured relative to our established “vacuum” 3-dimensional space drawn by the EM light travel. We can “think” of the extra dimensions as compacted circular dimensions, since this is not a bad way to visualize a space where only quantized values of wave oscillations (multiples of the circumference) are allowed (leading, for example, to our fixed nugget PLC wavelength, which would be one of those quantum instants, and to the fixed quanta of charge). In a sense, the mathematical concept and the “visual-Physical” is equivalent. The cms and meters are only an invention in our 3-dimensional space (and I mean “our”- driven by the way “we” sentient beings have organized the visualization of the Hilbert space via the EM dimensions).



Yang & Mills

Hermann Weyl

The concept of physics being the result of geometry was an old idea, but its scientific journey started in earnest with Einstein’s General relativity. Shortly, Herman Weyl (who identified the *gauge invariant* four dimensional curl of the geometric field with the electromagnetic field tensor, consistent with the Maxwell Equations, with the circular geometry of this structure determining the behaviour of electromagnetic fields and how they link to Schroedinger’s equation), Kaluza, Klein, Nordstrom, and a host of others quickly saw the links between Electromagnetism and geometry in additional dimensions. The ideas went to sleep for half a century, embers cooling in the back of an aging Einstein’s mind searching for Unification until his passing. Then came the

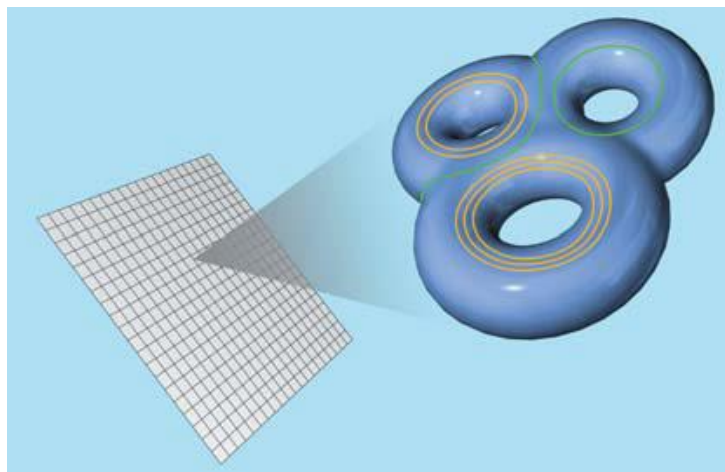
String revolution, QED, QCD, Super Symmetry and super-gravity, and the extra dimensions, many more of them, came back into vogue. Freund, Cho and others showed that, as one could simulate EM effects by having a gravitational like field in one extra dimension, Yang-Mills theories (Shaw's idea, analogous to Weyl's) could be extended by adding one more dimension (in three-dimensional hidden internal iso-spin space, a feature of nature's geometry manifested as different "charges", similar to the one-dimensional phase space in Weyl manifested as EM charges) for each additional type of field (charge type), with General Relativity acting similarly on each, even though those fields and particles were "different". The Symmetries of the Yang-Mills theories would arise out of the geometric properties in those extra dimensions, even explaining the "handedness" of nature we see.

Oscar Klein sought to incorporate the quantum effects in the five-dimensional theory, seeing the quantum of action as resulting from a periodicity in the fifth dimension. He also tried to relate the QM wavefunction to the equations of his 5D theory. In an early version of duality at work, Veblen and Hoffman would mathematically replace the Kaluza-Klein five-dimensional theory by a four-dimensional projective geometry. Maxwell's field Tensor F , and charge current tensor J are the analogues of Einstein's energy tensor T and the Weyl tensor C , with $E=8\pi T+\Lambda g$ being the source of the gravitational field (notice the cosmological energy term), like the charge source in EM.

As Michio Kaku says, "If we take Einstein's theory in higher dimensions beyond the fifth... Einstein's theory in N dimensions then reduces to Yang-Mills theory coupled to four-dimensional gravity." If we add more dimensions to Einstein's theory, their higher-dimensional vibrations reproduce the W & Z bosons of the weak force, and the gluons of the strong force, with geometry providing the unification. He adds: "String Theory must incorporate Kaluza's compactification scheme if it is to become a realistic theory." While "The weakness of this compactification... is that we still cannot answer the questions raised by Kaluza 70 years ago, for example, why did the universe compactify in this manner", he also notes String theory shows the 10-dimensions to be stable, and can't explain it either. While "Oskar Klein's early attempts to unite the two lines of development [gravity and QM] failed, ... we aren't much closer now to a unified theory of matter" (Jagdish Mehra).

Compactification, however, is the key to quantization, and remains essential. Compactification is also essential to describe the hierarchy problem, since the 5D Klein-Gordon equations in Kaluza-Klein's scheme show an "effective Mass" of m/R , where R is the size of the compactified circular (periodic) dimension, which might explain the discrepancy between the strengths of gravitation and EM forces. The Dilaton scalar field for the 5th EM dimension (alternatively the radion), corresponding to the size of the dimension, carries the EM impact into the gravitational realm. Meanwhile, the EM coupling constant is relayed by the inverse of the size of its compacted gauge group, and is correspondingly larger. Regardless, the full set of Maxwell equations follows from a simple action principle in this theory. "We can "explain" electromagnetism in a quantum description as resulting from a dial-like phase dimension in the geometry of nature in which only relative phases matter. ... This is called *local gauge invariance*, but it might just as well be called the *principle of relativity of quantum phase*" (Marburger).

Berndt Muller has demonstrated that a classical system operating in five dimensions can morph into a quantum one when observed only in four dimensions. Quantum weirdness is a reflection of the various interconnections that that hidden fifth dimension provides. This aligns with Gerard t'Hooft's (the Dutch genius who renormalized Yang-Mills, and always has a "crazy" idea that works) idea about quantum systems differing from classical system by loss of information – in this case losing the details of the extra dimension. The various "options" of the extra dimension get reduced to an "attractor" solution, being a discrete option summarizing the continuous aspect of that full solution. Bousso has also derived Heisenberg's uncertainty principle from the holographic limit, another dimensional aspect.



Zichichi suggests our four-dimensional space-time is “the result of an expansion of hidden dimensions – both of bosonic ($10 + 1$) and fermionic (32) nature – whose number could be as high as 43: this is the superspace”. He insists we must abandon point-like descriptions to non-point-like elementary entities – as does our string photon PLC picture.

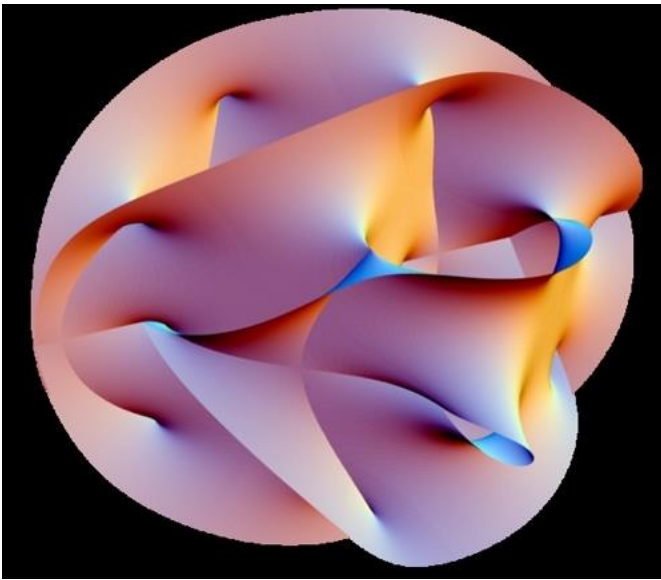
Kaku concludes that “Einstein was on the right track” (☺) in trying to generate subatomic physics via geometry. He thinks the ultimate M-Theory should originate from a simple paradigm, geometry itself. Schroedinger had wondered what law replaces the geodetic line of general relativity in the case of electron orbits. Kaluza had given a hint, but was largely ignored.

As Kaluza (who initially introduced the additional dimension as a mathematical crutch on a hint by Weyl) said, noticing the remarkable identity between the formulations of electromagnetism and general relativity, it is “hard to believe that all these relations in their virtually unsurpassed formal unity, should amount to the mere alluring play of a capricious accident.” Einstein agreed. A good idea never goes away.

Time of course being an additional “dimension”, “emergent” from the travels of the photon, relating the causal sequencing of subsequent PLC instances. Time is the “Causal” perception Dimension- perhaps the “Human” dimension, since it ties most closely with our consciousness and logic, with the three spatial dimensions being “an internal property of human intelligence, so to speak”, as Poincare would say (“Science et Methode”). The Uni-directionality of Time and the thermodynamic arrow would then naturally follow from our “causal” framework and assumption on the workings of the Universe, and our “event” interpretation of Space-Time.

A word about “visualization” of dimensions. In a logical, mathematical world, the “infrastructure” builds up according to mathematical rules, which we “visualize” in our mathematics, the language of those rules. If we can understand the mathematics, we can “visualize” the structure. The fact that normal, untrained eyes cannot “visualize” it is easy to understand: we are an emergent product of this infrastructure, which has “condensed” in a 3-dimensional form, and evolved its basic instincts to deal with that condensed state. It had no need to “visualize” the underlying system that led to its formation, until we evolved enough (only recently) to be inquisitive about it. Once we started asking questions, the paradoxes appeared. But our minds

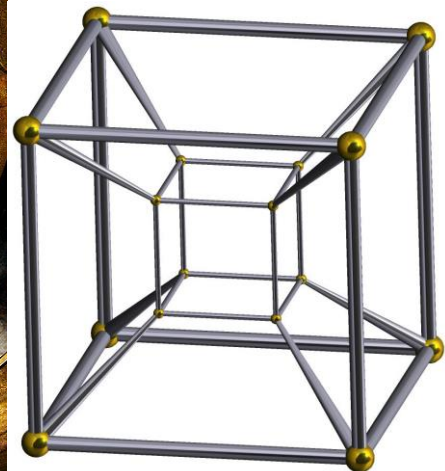
then developed Mathematics (already inherent in us, since we are a mathematical construct), and through this new tool are now able to visualize the other dimensions and constructs. It is not “basic” or intuitive, but it is our own never-the-less.



Calabi Yau



Nordstrom



Takeaway: We live in a multidimensional world. The matter and energy live in dimensions other than our 3D frame, which is simply the home of the Ether and the pilot waves, creating the map for the movement of the other dimensions.

5.8 - CONSTRUCTS OF THE MIND

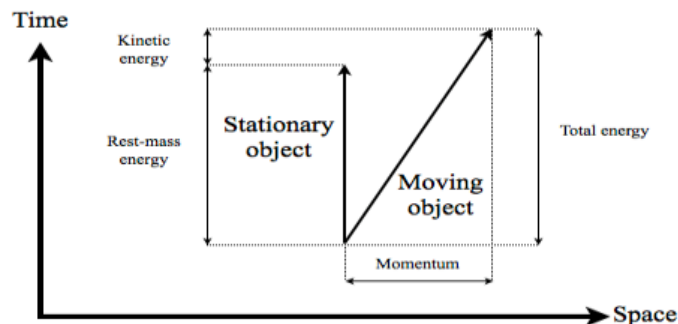
An interesting way to look at Space and Time, Mass and Energy.

Space and Time being ways to see “events” in the Hilbert Space, they are joined together in a single 4-dimensional spacetime.

Our mind constructs a 3-Dimensional Euclidean map to plot those events. Our memory constructs a linear time dimension to order them. It is a “reasonable” thing to do in the world we live in, with low speed (relative to the speed of light), and relatively flat space. Those dimensions are our way of ordering the mess around us. When an event happens in “space” (i.e. a change in position in the mesh), we count it as a space event (with no time change); when it happens in “time” (event in same position in mesh, while environment changes), we count it as a time event, and move the clock forward. Special Relativity follows.

The fact that those dimensions we construct do not exactly map to the “real” world results in the paradoxes of Relativity, and the various “effects” of forces, gravitational and otherwise.

Now recall that Mass & Energy (or Mass-Energy) are a facet of spacetime, being the warps in the fabric. Therefore they are part and parcel of the spacetime dimensions.



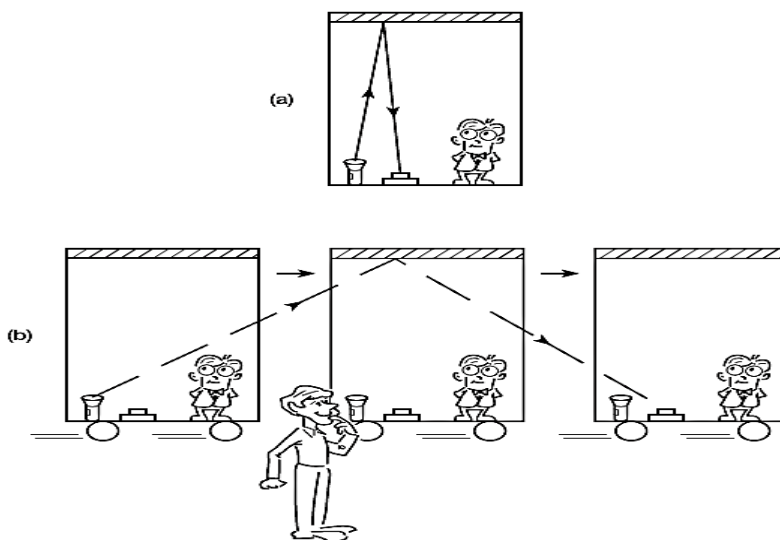
You can see Energy (when used to describe radiation, like photons) as the activity in Space of the the spacetime fabric – it is the “action”, or energy, of a momentum/kinetic or “space event”. When a motion in Spacetime is purely in space, at the speed of light, with no time component, then this activity represents pure “Energy”.

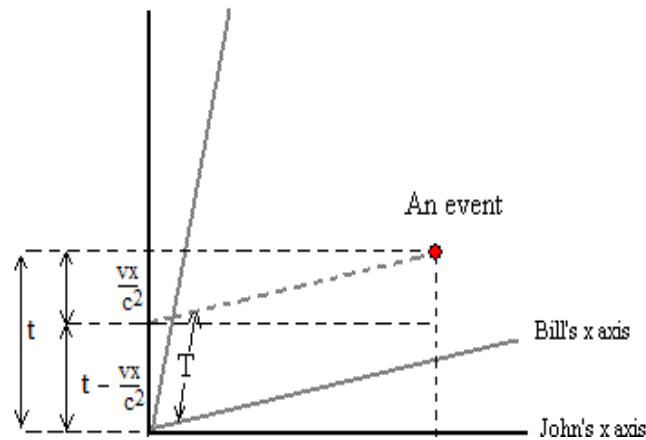
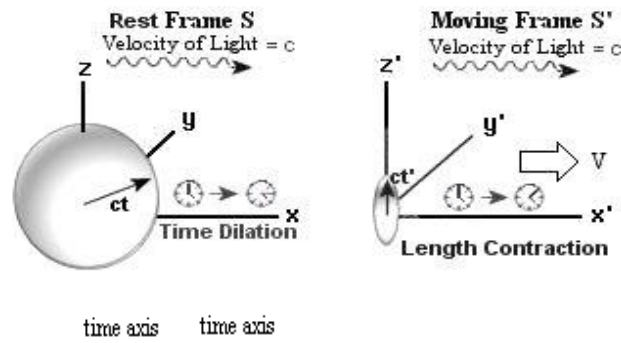
Rest Mass can be seen as an activity in Time, with no space component (fixed position, no motion in the mesh, no momentum). It is the energy of a “time event”.

When an event involves both time and space components (i.e. moving, but at sub-light speeds), then it is described by a “Rest Mass” relating to its time activity, and a “Kinetic Energy” relating to its space activity. C.N. Yang’s space-time construct has quantum time in chrones and energy quanta in erges, with time in chrones in one frame being energy in erges in another.

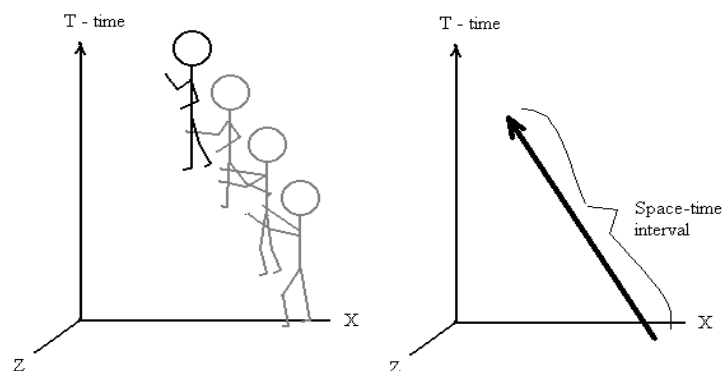
This way of viewing the world of events is a Human construct, one way of viewing the world, that works well in our environment, in which we evolved and adapted.

This can explain why we find that Energy and Time do not commute in QM, and why Position and Momentum also do not commute. It is because we have defined our worldview and our definition of 3D Space and Time to separate these domains. This “merger of physics and psychology” (Zukav) had survival value in a primitive world, but gets complicated as we jump the bounds of our early perceptions and poke into the microworld. This leads to paradoxes, since “Once such a set of idealized abstractions is erected (verified) in the mind we thereafter superimpose it upon all subsequent actual and projected sense data (i.e. upon the entire universe as we picture it according to this set of abstractions) whether it fits or not.” (Zukav). The ideas of Geometry and Time we use are mainly maps constructed by our minds, and it turns out the world does not fit that map exactly.

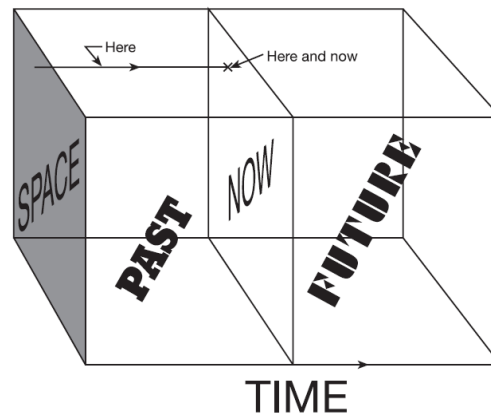




It turns out that a better map (Special Relativity) says that space and time are not absolute, but Spacetime together is. The “space distance” between “events” may change with an observer’s perspective, as may the “time distance”. But the “Spacetime Distance” is fixed, frozen in Weyl’s “Block Universe” or the “Space-Time continuum” Einstein consoled us with on the passing of his friend Besso. Sure, we’re not used to thinking in 4-dimensions, but then we pay the price in “paradoxes”. Similarly, General Relativity says our space is not Euclidean, but curved by mass and energy, and “straight lines” are geodesics and not Euclidean straights. Sure we’re not used to thinking in Curved Space, so we pay the price in other “paradoxes”, and make up things like “gravity” to explain them.



Minkowski showed that time dilation, Lorentz-Fitzgerald contractions, clocks slowing down, etc, were a matter of perspective of different moving observers. No “real” contraction takes place, and no “real” changes happen to the clock itself, but a perceived one. However, as demonstrated by the muon lifetimes in cosmic rays, and the Twins Paradox, the end results are all too real when you see that muons can reach the ground (which their “proper” lifetime would not allow) or the aging twin meets her younger traveling sibling.



With this worldview in mind (pun intended), and recognizing Space, Time, & Space-Time as emanent constructs of the Mind, it is important to revisit and rethink everything and everywhere we speak of “Speed”, “Time-Travel”, FTL, and Simultaneity. In a world of events, ordered by **our mind** in space and time, causality is King. Since we are macro objects and perceive macro events, our mental constructs and rules apply to that macroworld, PLCs and observables. Anything that conflicts with causality in that realm is just an illusion awaiting its Einstein. Time Travel is a no-no because our mind, which made up Time as a “dimension”, defined it such that “Time-Travel” would be a contradiction. Anything we “design” to allow Time Travel will fail, because it will come against our mind’s definition of time as the ordered construct of causality. FTL is possible, but information transfer is not, because it would violate causality. Pilot Waves change the field instantly, but do not transfer information. As long as our minds define the board of the game and its rules, our observations will have to fit with the rules of the board.

“The Objective world simply is, it does not happen. Only our consciousness... is as a process that is going forward in time.”

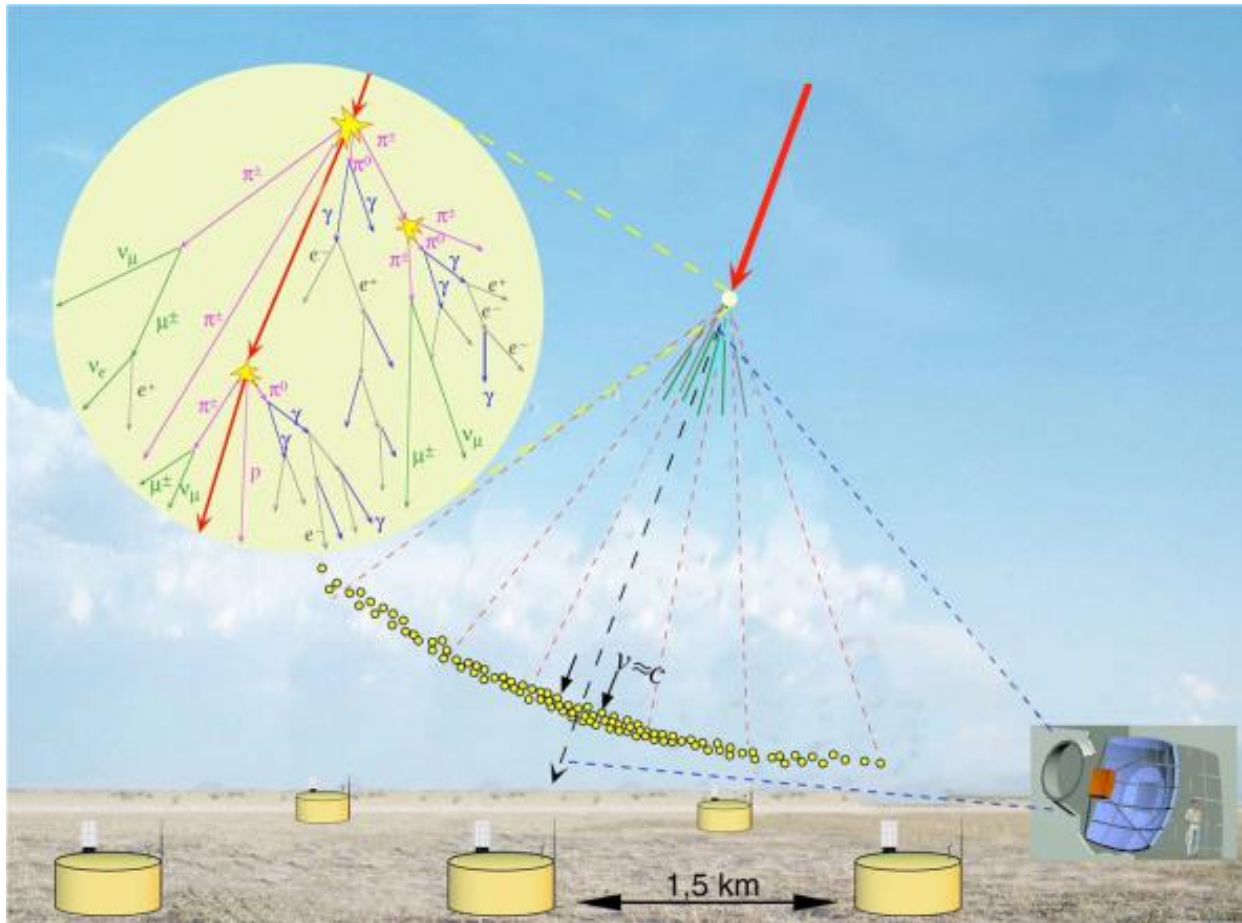
– Herman Weyl, on the Block Space-Time concept

5.9 - SYMMETRY IN ACTION

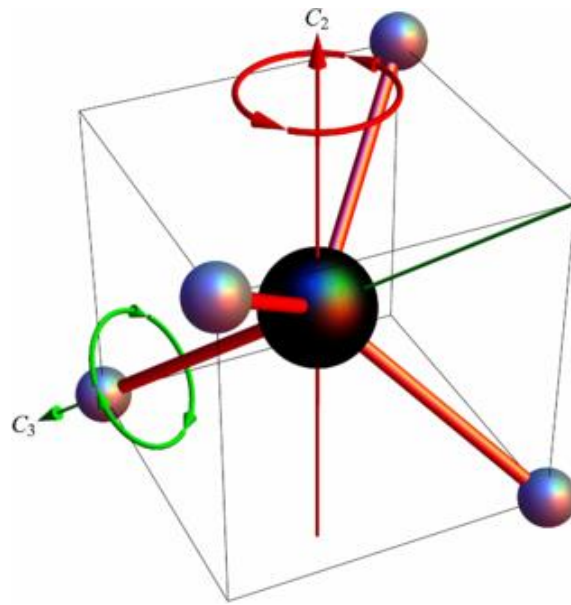
Symmetry, of all kinds, is a manifestation of (quantum) Dimensions in Spacetime.

The Symmetry of the Electromagnetic field exhibits that of a circle, hence a two dimensional, orthogonal manifestation of Electric and Magnetic effects, with a circular, symmetric disk of PLs moving forward at the speed of light. The size of the dimensions is “stretched” by the PL Density (Energy, pressure), resulting in the quantized $E=h\nu$ behavior.

The QCD “Color” symmetry is a spherical SU3 symmetry, and hence the 3 colors, R, G and B. Those would again be an orthogonal set of dimensions, with similar elasticity and behavior to the EM dimensions, except in a spherical instead of circular mode. The PL density in this case would be higher, with different elastic properties.



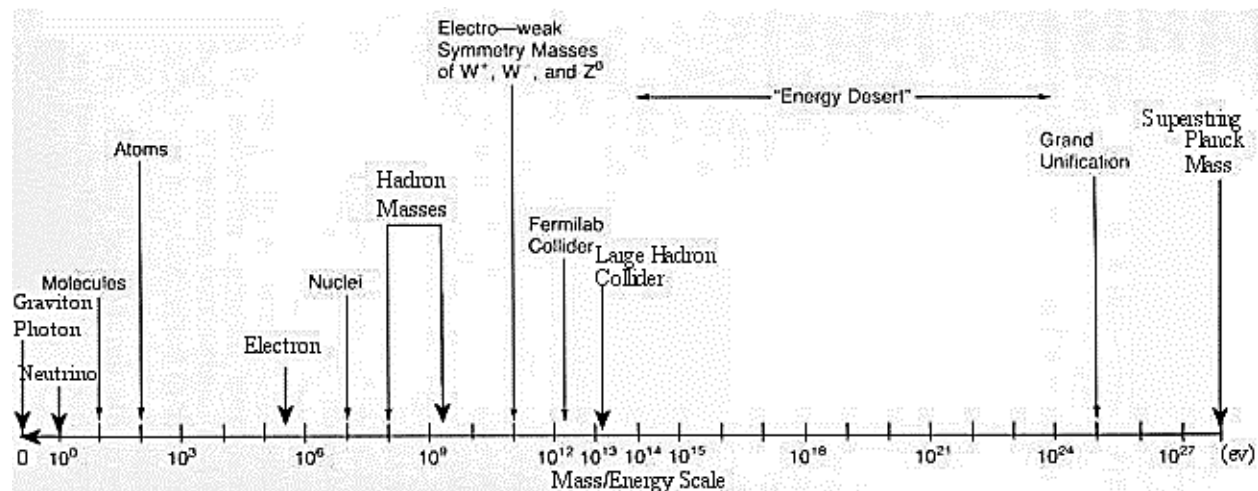
I propose that the transition between EM behavior and QCD color behavior starts to happen when we reach the frequency limit we calculated earlier, where the Energy per wavelength of EM radiation becomes equal to the total photon energy – at this point EM is no longer a linear sinusoidal phenomena, and the high PL density “opens up” an extra dimension, the resulting three dimensional flow (these are additional 3 dimensions, riding on our 3-D Euclidean space) then exhibits the QCD effects. Same PLs, different configuration, different “apparent” effects.



That is why the electron can be seen as an EM Photon trapped in a loop – its wavelength and size is in the range allowed for EM radiation. The proton, heavier and denser, is past the EM limit and therefore configured from “Color” Photons, also trapped in loops, those loops more complicated since they are around a sphere rather than a circle, presenting the structure of quarks. Depending on how those loops are structured, they would present the various types of quarks, and also a “charge” aspect if they are split in 3 circular motions, imitating an EM loop.

In this sense, talk of Unification of the forces and phenomena becomes irrelevant. In this Scenario, we say that EM radiation is valid only up to a certain energy, where EM oscillations are possible given the elasticity characteristics of the 2-extra-dimensions of the EM game. Above that energy, the EM behavior is no longer relevant- high energy Gamma rays being just

lumps of PLs (not EM oscillations), until they interact and form lighter particles with EM or QCD structures.



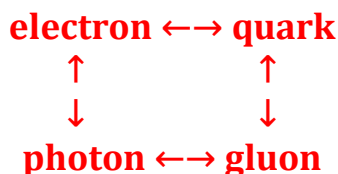
Above the EM limit, a different dimensional structure opens up, providing the QCD behavior. The higher PL density “overflows” a third extra dimension, and the SU3 symmetry of QCD comes into play. Basically the EM structure transforms gradually into the QCD structure. Hence our earlier comment on photons showing an EM as well as Gluon aspect.

Unification with Gravity is unnecessary, since Gravity is a scalar geometric effect in the 3-D emanent space that is a reflection/mapping of the “Energies” of the PLs from the EM or QCD dimensions. Its “weaker” strength a reflection of the mapping effect itself, with EM and QCD effects stronger in their own dimensions, but casting a dimmer shadow in the 3-D space. At very high energies (PL densities), the 3-D space warp (Gravity) would become high enough to start being comparable with the EM or QCD effects (those effects then essentially “merging”, since at those energies neither EM or QCD wave structures would be possible per our assumption here, having reached their “limits”, and the dimensional structure then changing again to another symmetry, perhaps SUSY or another type).

The power of Symmetry, or invariance, is shown by Noether’s theorem, where Nature’s various conservation laws pop out naturally as a result of various symmetries – most noticeably Energy conservation as a result of time invariance. Geometry rules Nature.

As discussed by Wilczek in a slightly different context, the “Grid” of the PL Mesh can be seen as a cosmic “super-conducting” layer on which the different

forces are displayed. With an SO(10) symmetry, one can see the various Electromagnetic, Weak, and Strong forces interchange roles. The various mappings should come naturally, since per our PL proposal all those “particles” and Bosons are made of the same material, acting differently in different “dimensions” representing the various aspects of the symmetry:



The weak force is also seen as a result of “green and purple” charges, whose different modes give the W & Z particles.

I see the transformations being affected partly by differing elasticity constraints of the PL mesh, at which the PLs may shift between the various color dimensions depending on the energy levels involved. Using the American color convention of Red, White and Blue for the strong forces, Green and Purple for the weak charges, and with each charge rotating in a two-dimensional plane (like our EM picture), we get the SO(10) group of transformations. The N in the diagram below represents the particle that gives the neutrinos their tiny mass, as well. The Electric charge (called here the Hyper-charge) is a mix of the above, emphasizing the joint identity of the various charge contents, even though they are distributed in different “dimensions”- EW theory sees what we call electric charge as a combination of charge that gauges rotations of phase (our “regular” EM) and the charges that gauge rotations in the weak isospin space.

$$Y = -1/3 (R + W + B) + -1/2 (G + P)$$

Again, those dimensions are in the PL Hyper-space (the Hilbert space), and are not “distance” dimensions, but configuration dimensions in that space; “distance” comes in only in our 3-D PL Mesh, Grid, constructed by our senses.

In this scenario, the PL mesh/Grid can be seen as the Higgs Field, with the various particles clusters in extra-dimensional configuration space overlaid on that Higgs Field; The Higgs mechanism would be a way emanations from that field get their “Mass”, essentially ways they can be looped instead of free propagations, with something like a Higgs Cluster (Higgs Boson warping the space) initiating those configurations. The various condensate excitations of

these broken symmetries (of internal dimensions like Schroedinger's phase or isospin space) would just be different allowable cluster configurations appearing from that Mesh. The different properties of the forces (like Asymptotic Freedom, etc.) derive from the configurations in those extra dimensions, and the various "screening"/"anti-screening" effects they generate. A specific symmetry breaking of QCD (proposed by Peccei and Quinn) may even justify proposals for "Axions" (Weinberg, Wilczek), the weakly interacting particles that could be our Dark Matter clusters (that might have been detected in PVLAS experiments in Italy). The various kinds of gauge particles like gluons/ photons/ W&Z particles implement the various transformations between the various symmetry configurations.

	R	W	B	G	P	
u	+	-	-	+	-	
u	-	+	-	+	-	
u	-	-	+	+	-	
d	+	-	-	-	+	
d	-	+	-	-	+	
d	-	-	+	-	+	
u^c	-	+	+	-	-	
u^c	+	-	+	-	-	
u^c	+	+	-	-	-	
d^c	-	+	+	+	+	
d^c	+	-	+	+	+	
d^c	+	+	-	+	+	
ν	+	+	+	+	-	
e	+	+	+	-	+	
e^c	-	-	-	+	+	
N	-	-	-	-	-	

SO(10)

Hypercharge $Y = -1/6 (\mathbf{R} + \mathbf{W} + \mathbf{B}) + 1/4 (\mathbf{G} + \mathbf{P})$

We can see those "dimensions" as either appended "quantum dimensions" overlayed on the superconducting Higgs Field, or see the whole field as a

multi-colored, multi-layered superconductor. Whichever helps visualize the scene, the math would work out the same, since these are all in configuration space, and only the 3-D aspect is ultimately visible to our restricted EM vision view. In Supersymmetry, Motion is between the dimensions, which is more like a “spin” change than actual displacement, since the PLs are at the same 3-D node as they move between the extra dimensions. We see the differing “spin” in the different dimensions as different particles and effects. Some of the spins result in different configurations that are reflected as “mass” as well.

Nature preferring to repeat its tricks, the same type of effect that slows down photons in electrical superconductors (due to electric current generation), causes the Mass effects on the W& Z particles due to supercurrents of purple weak charge and hypercharge (related to electric charge) in the superconducting PL mesh (including perhaps a mesh layer in the compacted tiny curled up dimensions, with corresponding strong and weak current generation).

The Higgs field, “a pervasive condensate throughout the universe that influences all other matter”, (our PL field), hints that “The Standard Model seems to be a fragment of a larger framework” (Marburger). The rationale for Supersymmetry is very powerful, and already the Standard Model’s success, and the discovery of the Higgs Boson at the LHC, have strengthened the case for it. The equations justify the extrapolations, just as Maxwell’s equations predicted radio waves, Dirac’s the positron, Glashow, Weinberg & Salam (GWS)’s the W & Z particles, and Gell-Mann’s the Quarks and Gluons. Hopefully future Accelerator experiments will untangle the rest of the quilt pattern.

“The new theory sees a world based on a multiplicity of space-filling Ethers, a totality I call the Grid.”

Frank Wilczek

5.10 - SOURCES & SINKS

So where do the Photons come from:

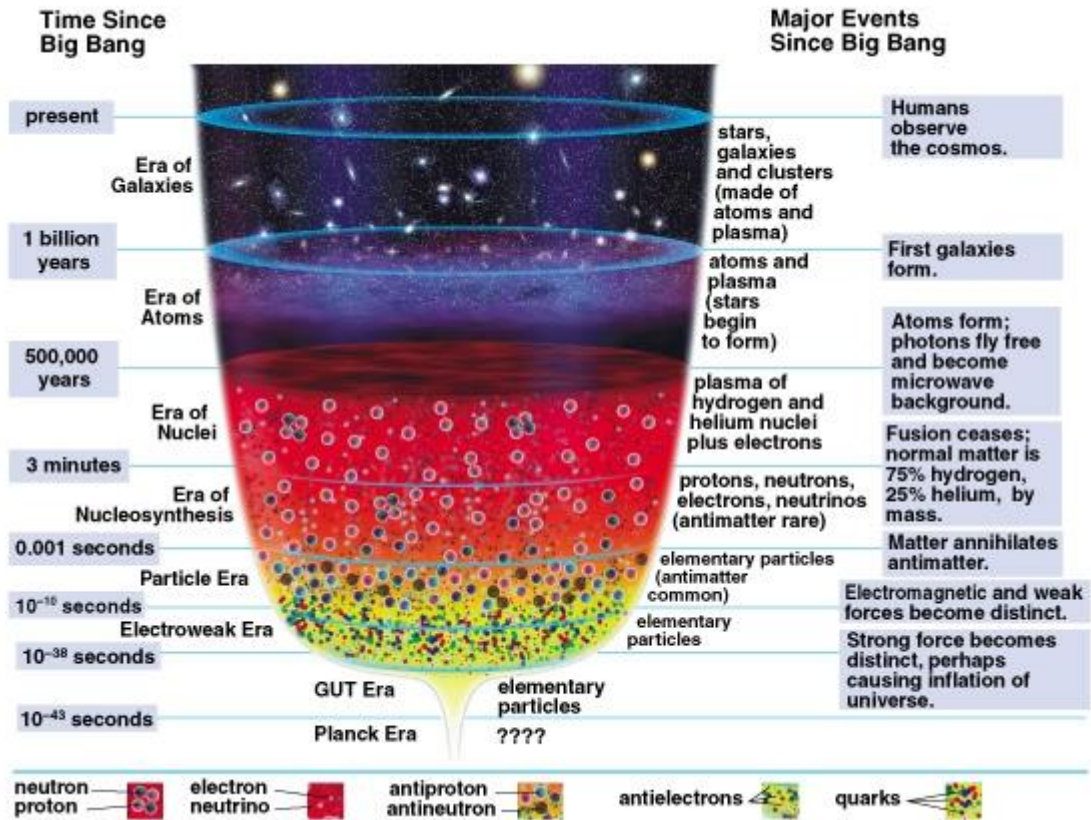
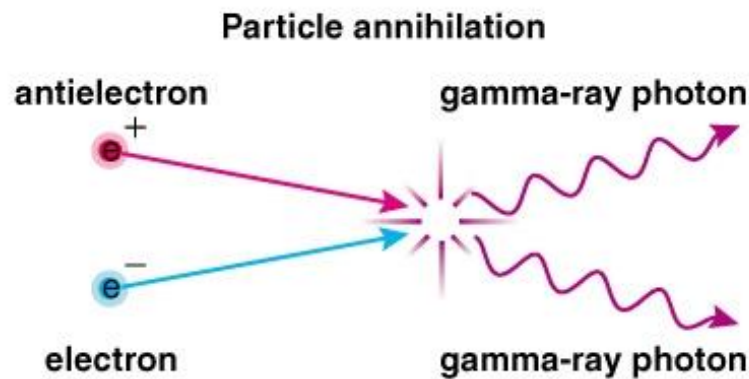
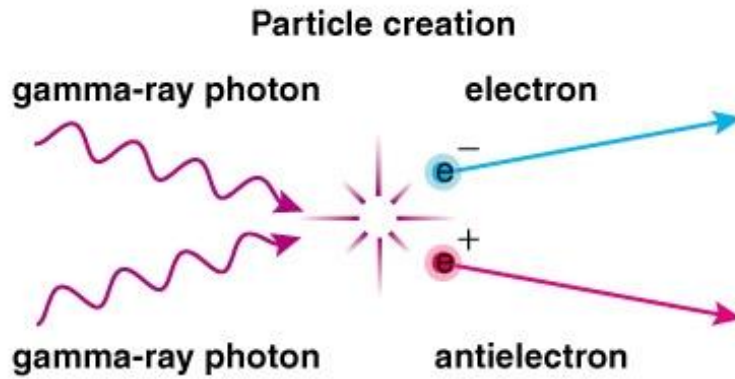
- At “Creation” (see First Singularity below), the initial node, having accumulated a high additive PL supply, starts to unroll (uncorrelated) into additional nodes, creating space. As soon as additional nodes are created, the huge PL pressure would push the PLs into the other available nodes – pronto: Radiation.
- The initial set of nodes would still be oversaturated, and extreme likelihood of node generation follows. This extremely high energy state cannot really be defined as photons or other... Plasma may be more suitable... The scenario follows standard Inflation/Big Bang cosmology, with the density decreasing to the point when photons emerge, particles start to form, etc. This is where the majority of the photons get created... after which they run around the universe.
- In the Universal Vacuum (the “empty” nodes in our current Universe, which have at least one PL marking the node, but very low density), continuous PL creation would cause oscillations and clustering, with those clusters being possibly “virtual” particles that get undone quickly (cluster breaks up - diffuses), or get tight enough to continue as photons or other particles. This is the continuous creation of Photons and Energy that adds to the Mass/Energy of the Universe, in addition to the “Vacuum” energy of the “empty” space.
- The Vacuum variations above would also cause increased photon creation when the space is restricted, as in the Casimir Effect experiments, since the shorter distances increase the magnitude of the oscillations on PL density, increasing photon production, as well as warping the intervening space, resulting in the “pull” of the “Casimir Effect”.
- A special source of Photons are the Giant mills of matter seen in Quasars and Supernova, where matter is recycled back to Energy, in the form of photons. Their Gamma Ray radiation may not be good-old-regular photons as we have seen above, as their energies go above certain cutoffs, changing their nature from sinusoidal waves to perhaps an abrupt, non-linear high energy packet transmission. Ultimately, however, as they interact with matter, they create lower energy photons in the process.

- A unique source possibly of very high Energy Gamma Ray radiation photons could be exploding small black holes theorized by Hawking and Penrose. Those explosions would replicate the initial Big Bang, with one difference: Once the Black Hole reaches a point where it “lets go” of its PL cluster at its singularity, it immediately has open space around it (which the Big Bang had to toil to create). So the PL cluster would zip out in massive PLCs which would represent the extremely powerful “cosmic” rays we see, their energies well above the Greisen-Zatespin-Kuzmin limit, the PLC not having sufficient time to spread out and disintegrate in its flight.

Where do Photons go?

- The ongoing “stray” Pilot waves may derive from and reduce Photon Energy, and Photons would slowly lose energy over cosmological time. This would be a very slow process, not likely to cause depletion in cosmological timeframes, even though it might have a small effect on certain Red Shift measurements.
- In proper collisions and environments, Photons could end up forming matter (electrons, etc), as normally observed in collider experiments.
- For practical purposes, though, the number of photons in the Universe changes very slowly in the cosmological times to date.



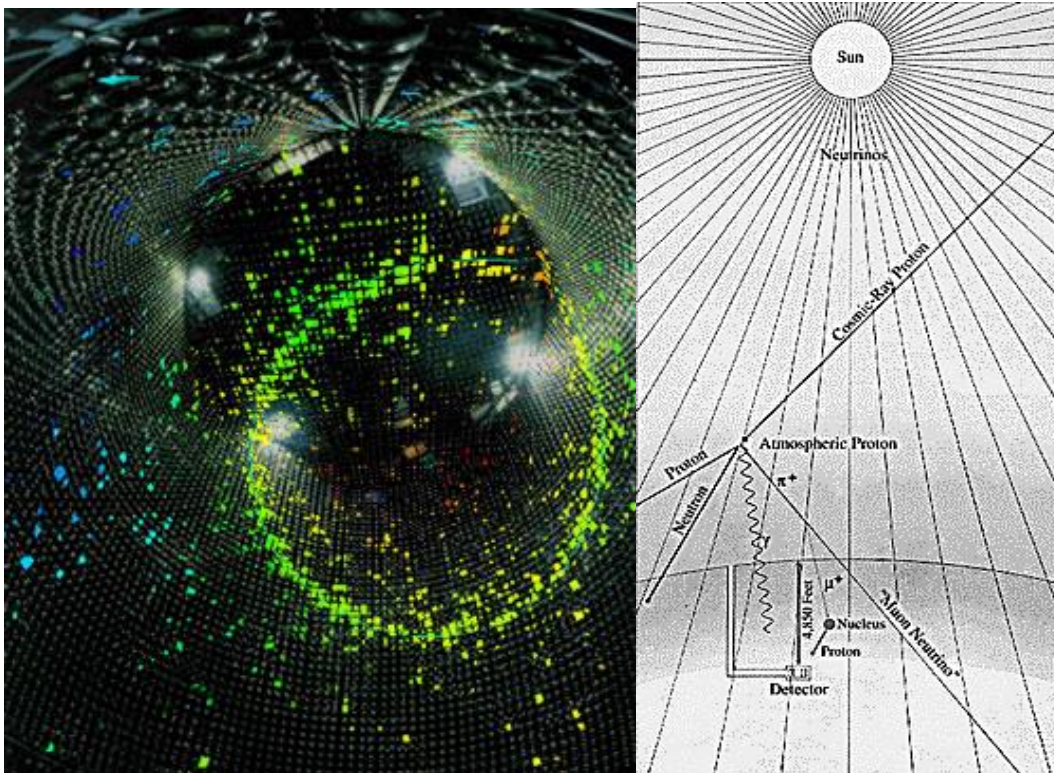


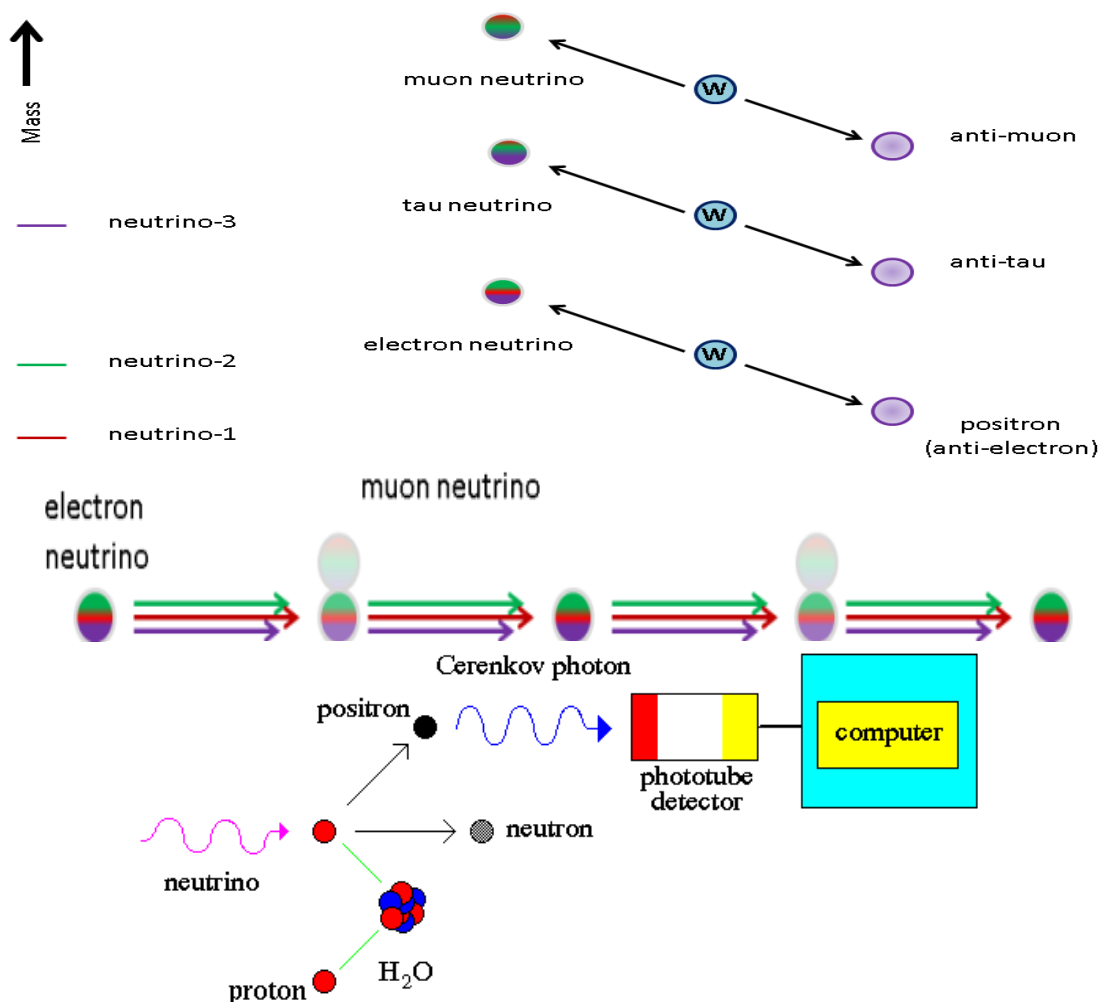
5.11 - NEUTRINOS

Neutrinos are the Photon's cousins. Without the electric baggage, or the magnetic charisma. They are the “weak charge” photons, given a small mass by the Higgs field super-conductor molasses.

Neutrinos would be similar PL clusters, in a particular configuration setup that is very close to Free, but still causing a residual tiny “Mass” effect – their Lepton nature indicative of a similarity to Electrons, also a photon form in our picture. That is why they travel close to the speed of light, and have undetectably small masses – the electromagnetic mass of the electron missing in this case, due to the particular configuration. They would travel in a dimension of their own (the “Weak” color dimensions, Green and Purple), allowing them to cross lightyears of matter without interacting with the EM waves and PLs in the other dimensions.

The three neutrino “flavors” would represent different modes of flow & configuration, depending on the neutrino source. The fact that neutrinos “oscillate” between flavors in flight would indicate the three modes are interchangeable, with the neutrinos occasionally flipping between modes, yet still undetectable due to their lack of an EM-type wave.



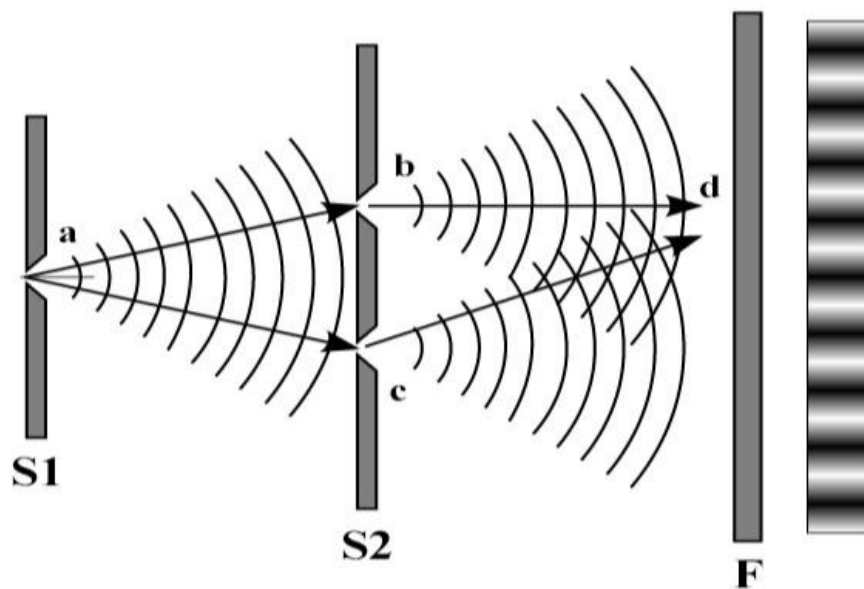


The similarity between neutrinos and photons did not go unnoticed. De Broglie suggested photons are composite neutrinos, with two neutrinos forming a photon in his “neutrino theory of Light”. Many contributed to this theory, including Jordan, Heisenberg, Winter, Stueckelberg, Born, Nagendra Nath, Pryce and Pauli. The Maxwell equations for right and left-polarized photons are analogous to the Weyl equations for right and left-handed neutrino fields. Pauli’s neutrino equation was identical to Dirac’s electron equation with no fields.

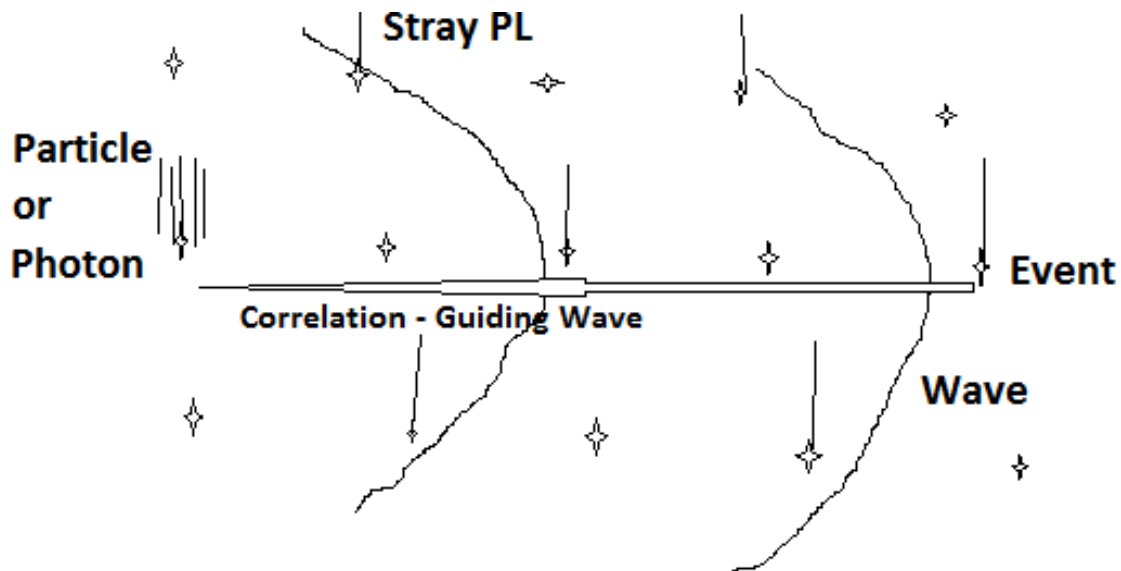
To complicate matters, “massive” neutrinos in the form of majorons, are suspected to be the progenitors of the Higgs bosons, and the source of the imbalance between matter and anti-matter. Their affinity to electrons (minus the charge) is also noted, as is their interaction with Z neutral currents. To date neutrinos remain elusive, and their essence may still explain many mysteries.

6 - PARTICLES AND WAVES

Particles, including photons, are essentially large PLCs in motion. By Large, we mean a “huge” number of PLs clustered together. While the PLC moves together as a pack, like all packs a few stragglers and a few fidgety ones will stray from the pack. In Hilbert space, this would mean individual elements would increase their distance from the “center” of the cluster, forming its “wavefunction”, its Pilot wave. Starting together, however, they remain entangled together at the Nil-Source, still part of the “Correlation” of the particle.

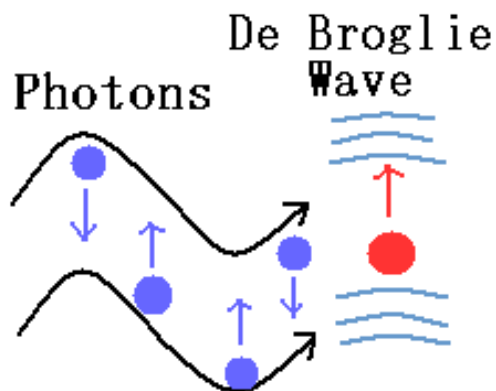


Those “stray” PLs emanate from the source, escaping from the higher dimensions to our 3D Mesh dimensions, forming waves in their wake, with the particle following or leading them. As they travel, they will occasionally hit a target (a measurement tool, a screen in a slit-experiment perhaps). Their wake would trigger a “conduit” for the mother ship, directing it to the event. A “Guide-Wave” is born. The resulting impact looks like the particles have a wave aspect, since their pattern of impact would mirror the interactions of their respective “waves” of strays. Multiple Photons would look like they “interfere” in a wave pattern, as they are individually directed to where their strays fell. Attempts at measuring the “path” of the photon would catch a stray, and redirect the conduit, while focusing the other strays, disrupting the “wave” action. This “picturesque” wording is formally captured in De Broglie-Bohm’s pilot wave function and trajectories.



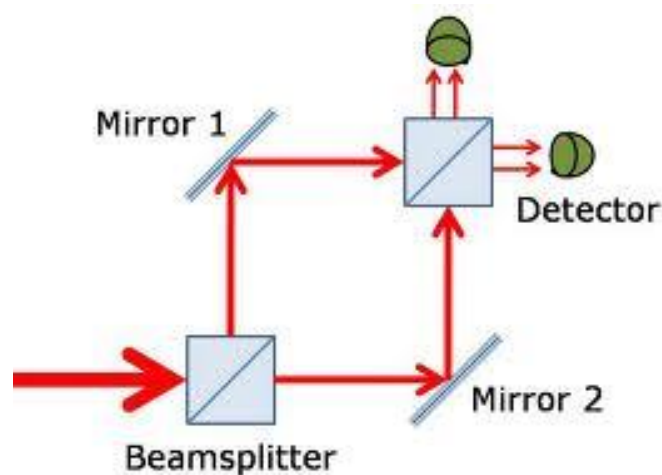
Particles and Waves

The “density” of the catch-me-if-you-can stray PLs providing the guide-wave would present the “probability” distribution curves QM postulates. The same effect, when hitting a measuring instrument, brings the particle in, “collapsing” the wave function, so to speak. The timing/scope of the “Decoherence” would depend on the specific configuration, an image of the Hilbert space correlations at play. Hence this behavior could appear for photons, particles, and entangled combinations of particles (atoms, bucky balls, etc) as has been demonstrated. This interference could happen even with single particles, as their wave patterns repeat individually, and add up “over time” even though not coexistent simultaneously.



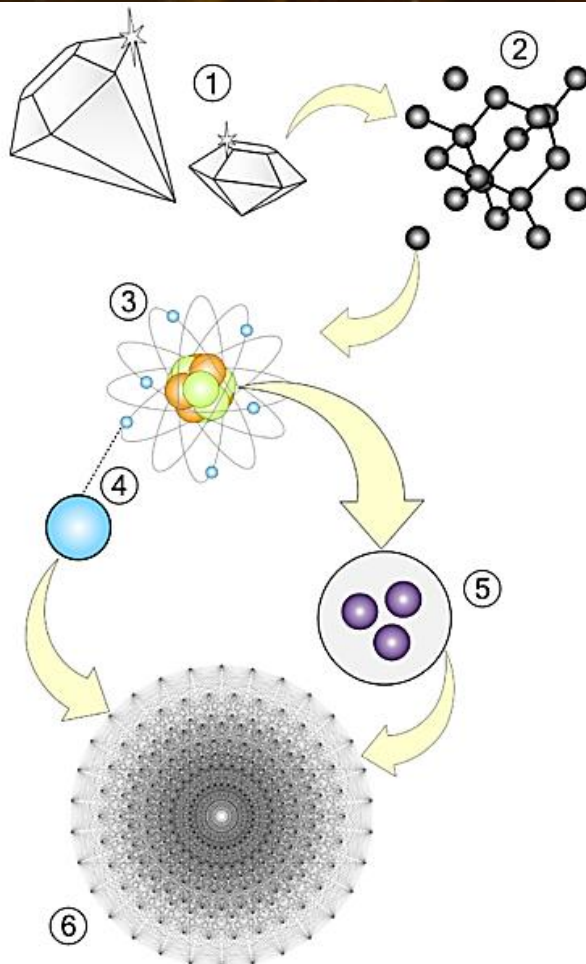
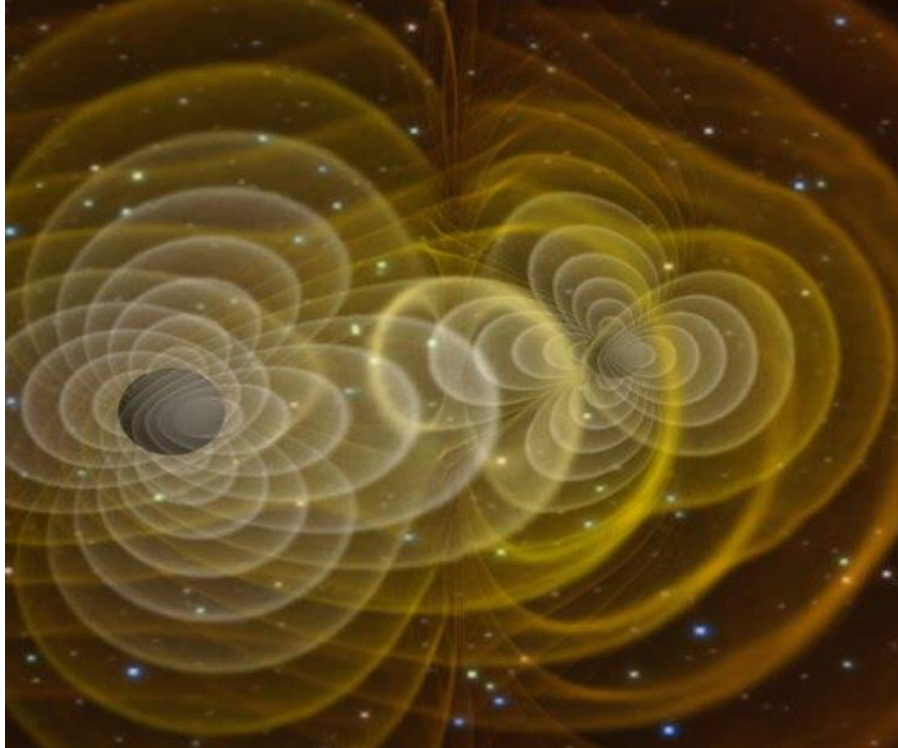
By following the guide-wave, with its many scouting “probes”, the particle would be tracking all the possible path options available, replicating Feynman’s path integrals and Sum-over-histories approach. It would be

natural for the Hilbert correlations to take the shortest path, which translates in perceived reality as the least action principle. This Pilot Wave approach would gratify de Broglie, and replicate the under-appreciated Bohmian Mechanics that succeeds at duplicating Quantum Mechanics' results, but now gives it a "Physical" (Logical), ontological support. Split beam experiments where light seems to follow "both" paths is one example of this phenomenon. The "Photon" itself (the "particle" part) only goes one way, but is guided by its Pilot waves (which go every which way), the bulk and the Pilot being part of the same correlated entity.



A new definition of an entity is in order. We keep saying that a photon is a wave, or a photon is a particle, depending which way you "look" at it. That means literally it is BOTH, and both components form part of the entity. So the Photon is a PL Cluster undulating in the EM dimensions under PL pressure, accompanied by Pilot PLs propagating from it in the 3-D mesh (but correlated to it in the Netherworld source, in their Hilbert Space (Configuration Space) function), and the combination is the Photon that behaves the way we see. We should take our words at face value, and resolve the mystery by believing them.

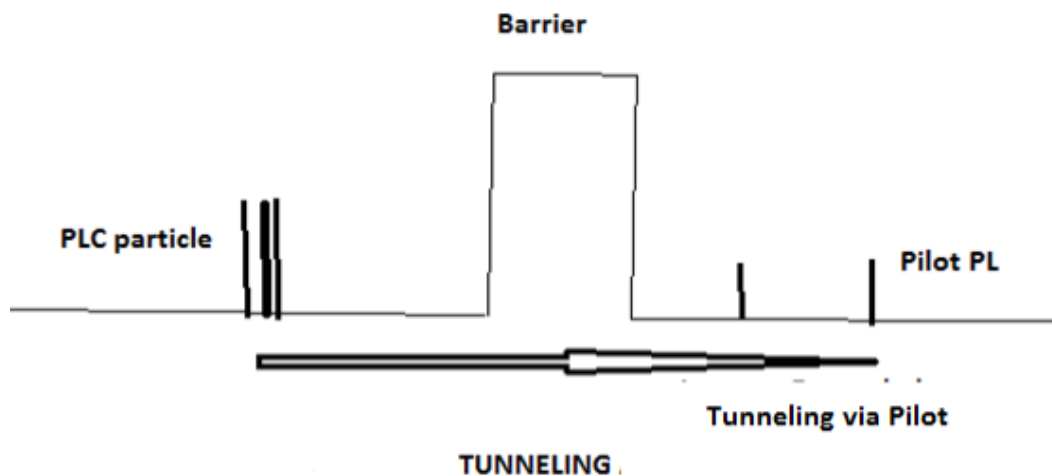




6.1 - TUNNELING & ENTANGLEMENT

The “waves” of Stray PLs emanating from a PLC would propagate, crossing potential “Barriers” to the PLC in motion. Such Barriers could consist of a PLC “Wall” or other manifestations of Matter.

The individual Pilot PLs would be able to penetrate that Barrier, being much smaller than the larger PLC of the particle. They would create a decaying wave past the Barrier, where “events” there would “collapse” the wave and bring about the “Tunneling” effect, with the particle “guided” past the barrier to its pilot PL location.

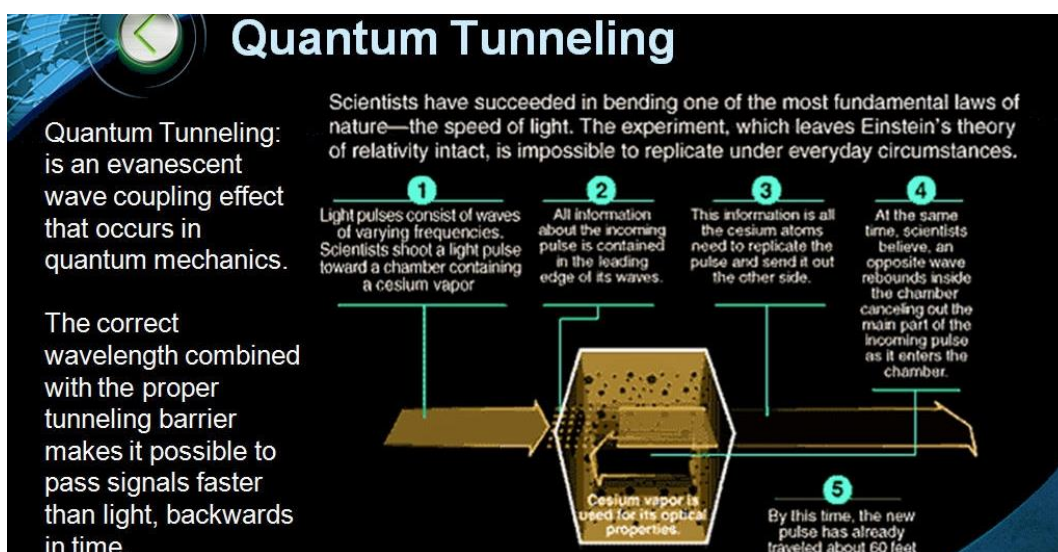


A different scenario applies for Entanglement, where Entangled PLCs can impart the effect of their characteristics to the other entangled PLC location. This influence is enabled by the correlation of the PLs at the Nil-Source, relating the PLC node to another location in the Hilbert space, whose space mesh is aligned with it when they become entangled. When we measure one PLC, we re-orient its entire isolated mesh to the macro world, which instantly aligns the other PLC's entangled mesh. Note, however, that the full PLC cluster does not “change” or react, since individual PLs are really just logical constructs that don't “physically” move when they jump, but are simply re-aligned due to the redefinition of the entangled mesh at the far location. This boils down to a sort of information transport in Entangled states, carried by the instantaneous re-alignment of the isolated entangled mesh at one point, being carried instantly to the whole island ... which is the scope of current experiments for so called “entanglement”. The “information”, however, is just the alignment of the mesh, which does not carry classical information- any measurement at the far location will re-align the mesh there, shuffling the

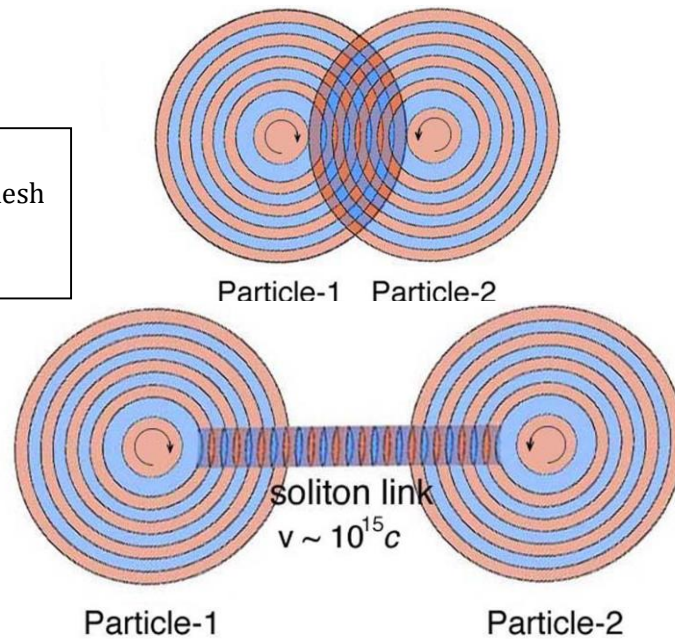
content again. “Measuring” one of the entangled pair is taking a peek at one of Bertlmann’s socks – after which the other particle is aligned as well, revealing its colors by inference. Measurement could be intentional, or just environmental decoherence as the particles touch the aligned macro world.

Helmut Rauch indicates that “a system remains coupled in phase space even when it becomes separated in any parameter space”. “Related bands of plane-wave components which compose the wave packets may be considered as a factor responsible for the understanding of coupling and non-locality phenomena in quantum mechanics”. “Spatially separated packets remain entangled in phase space and nonlocality appears as a result of this entanglement”. “This Quantum phase is really an additional structure – ultimately a *geometric structure* – attached by the complex wave function to each point in space” (Marburger).

Our view is that “entangled particles” are simply particles with a common space patch. In a sense, QM is correct in considering the entangled system as a single, non-separable system, described as one mathematical object. The non-local character of PLs in our 3D world, and the formation of a separate “sub-space” of the two entangled particles (isolated from the rest of the environment), makes them part of a separate world evolving together. When one of them is measured, their mutual dependence on the resulting “spatial localization” (the basis of decoherence) implies the other has a new “spin” basis, a reduction in degrees of freedom that correlates its properties to the measured particle. Instead of the dubious wave collapse, a “superluminal statistical re-weighting of outcomes” occurs.



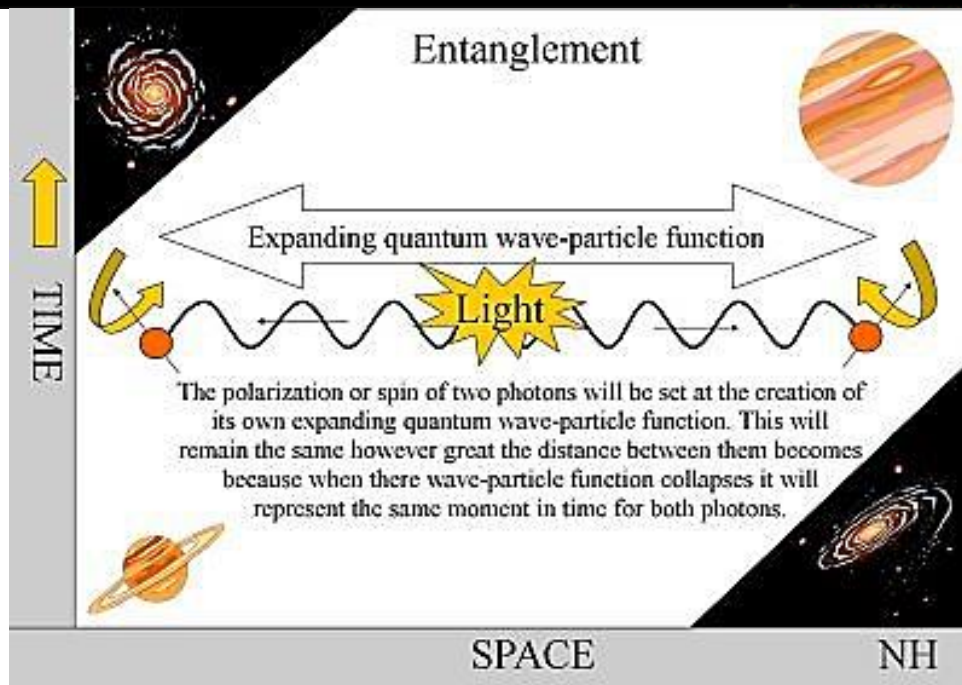
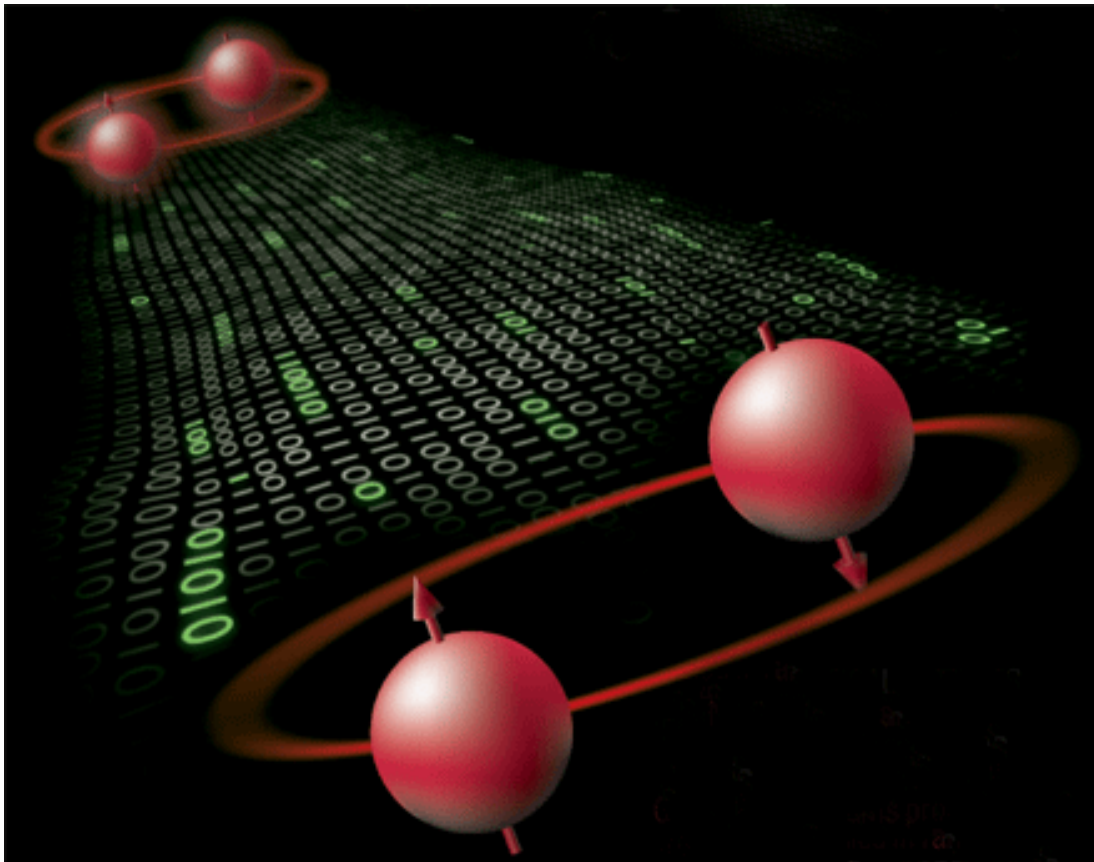
One view of the
Entangled space mesh
as a superluminal
soliton wave



In the diagram above light pulses consisting of waves of various frequencies are shot toward a 10 centimeter chamber containing cesium vapor.

All information about the incoming pulse is contained in the leading edge of its waves. This information is all the cesium atoms need to replicate the pulse and send it out the other side.

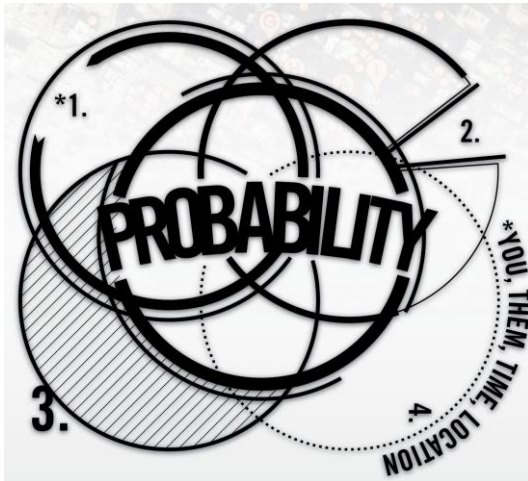
At the same time it is believed an opposite wave rebounds inside the chamber cancelling out the main part of the incoming pulse as it enters the chamber. By this time the new pulse, moving faster than the speed of light, has traveled about 60 feet beyond the chamber. Essentially the pulse has left the chamber before it finished entering, (looking like it is) traveling backwards in time!

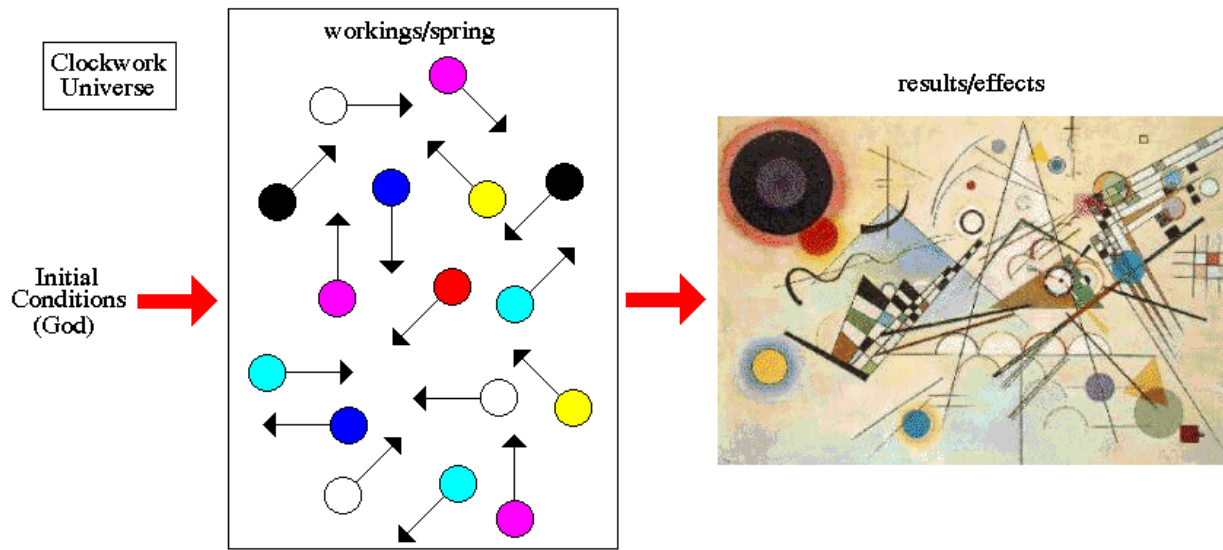


Takeaway: Entanglement is simply two particles sharing the same patch of Ether-space, this space being connected superluminally by its PL relations.

6.2 - PROBABILITY

The Pilot wave picture provides the background for the “probabilistic” nature of QM. That wave, representing a form of Schroedinger’s equation for the propagation of the Pilot PLs, influences the “motion” and location of the PLC when pinned down (event). While the PLC is always at a definite node, it will move as directed by the Pilot PLs, depending on the initial conditions (hidden variables), making its motion seem probabilistic due to our ignorance of the details of the initial conditions. The random “jumps” that so annoyed Erwin are gradual and deterministic, complicated by the turbulence of the butterfly effect of Pilot Waves.





Ψ = wavefunction for electron

$$\Psi = A \cos\left(\frac{2\pi}{\lambda}x - \omega t\right)$$

Using the deBroglie relationship $\frac{2\pi}{\lambda} = \frac{2\pi p}{h} = k$ p = electron momentum

Using the Planck relationship $\omega = \frac{\hbar \omega}{\hbar} = \frac{E}{\hbar}$ E = electron energy

The probability therefore derives from the wavefunction, operating on hidden initial conditions. The initial conditions, in addition to being difficult to determine, are also partly indeterminate by nature: They have to do with the alignment of the space node mesh at the first interaction, which is a random process depending on how that interaction starts.

Takeaway: Probability has many sources – initial conditions; the patchy nature of space of isolated particles; and a combination of both.

6.3 - DUALITY AND COMPLEMENTARITY



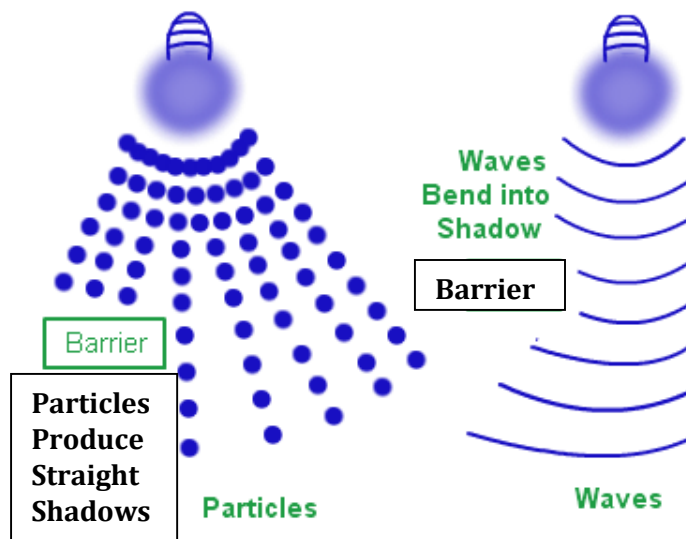
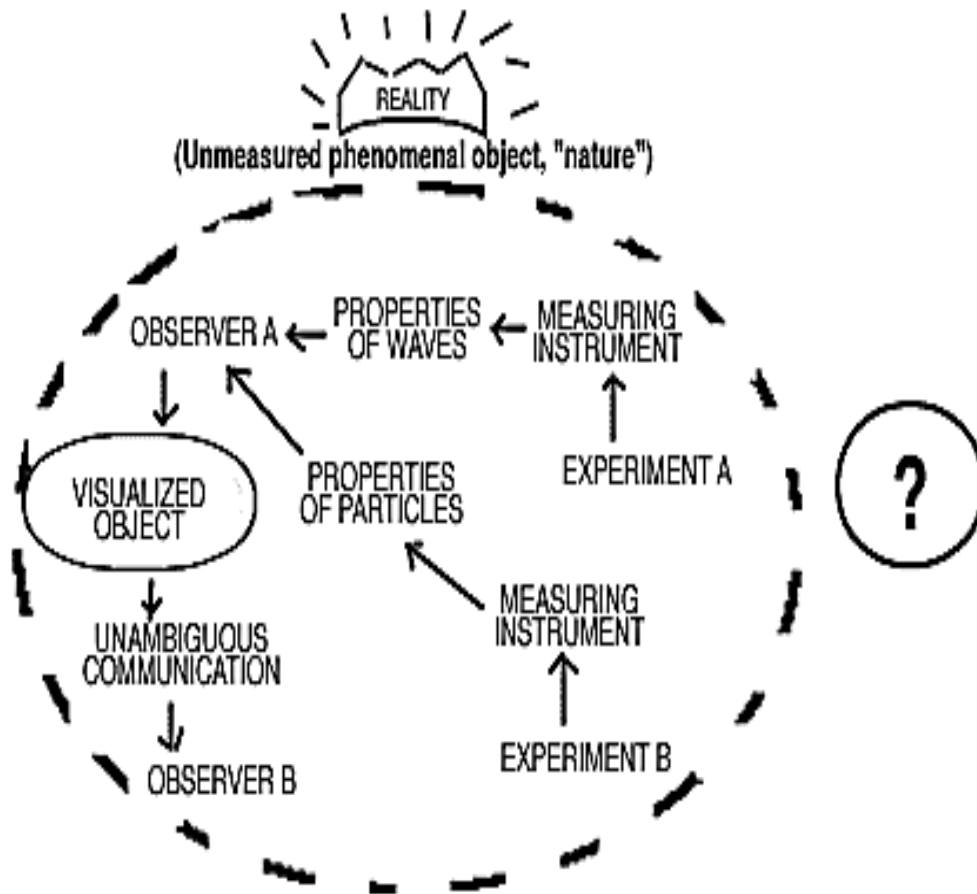
“The wave nature of matter can be inferred by making Planck’s relation relativistically invariant” (Marburger). More prosaically, The Duality between wave and particle, as we have seen, comes out of the PLC cluster and its Pilot PL waves.

The Classical-Quantum divide is the result of a deterministic, non-local entanglement effect, resulting from the duality of the Existence space and the Nether-world. The conflict between “reality” and the non-real results from the PL jumping between those two worlds.

Complementarity, the equivalence between the two views Bohr advocated, is therefore emergent. Measurement determines the game, in the sense of giving the context to what kind of “collapse” the Pilot wave causes, whether in measuring location or speed, time or energy.

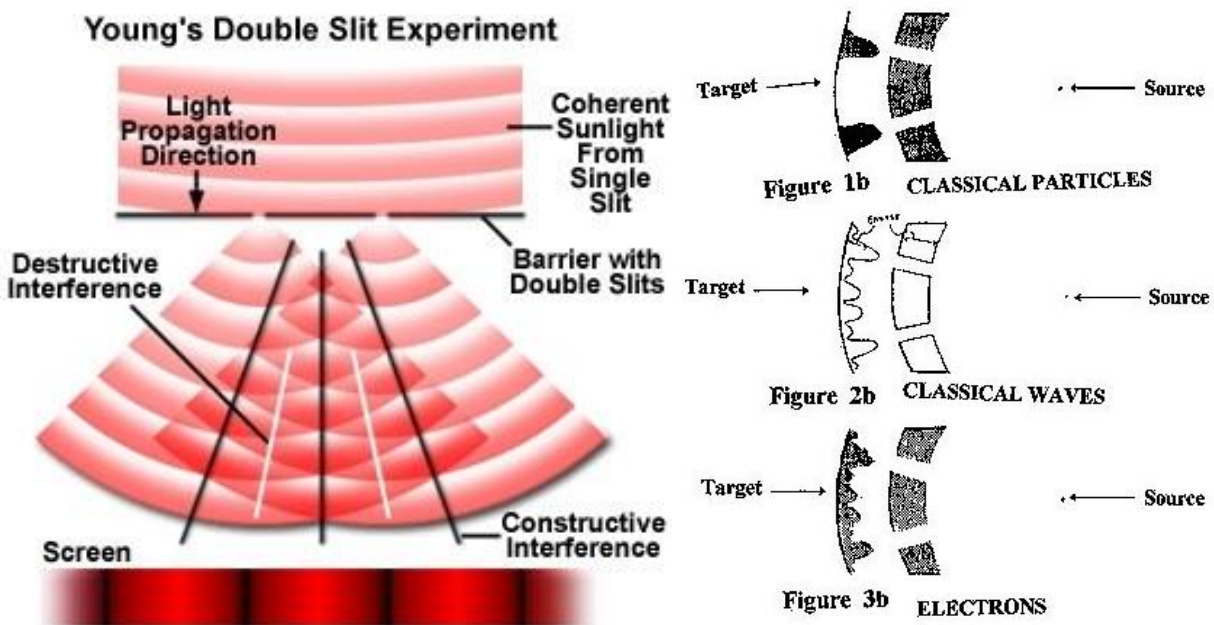
It is important to separate the distinction when discussing waves between “Pilot waves” tied to the particle itself, creating the entanglement effects and the probabilistic aspects of its behaviour, and “waves” as a high density field that are aggregates formed by the individual particles or photons, behaving in a classical way.

The Pilot wave does not carry energy, even though through its correlation with the main particle it can “bring in” the particle and hence has an energy impact.



The “heavy density” waves (say from an intense light source) look like classical waves, their frequency provided by the actual frequency of the photons themselves (which are the same frequency as the Pilot waves), which carry the energy of the photon “wave-packet”. Those waves simulate a “gas” of

photons at the frequency of the photon, whose density distribution would reflect the probability carried by the Pilot waves.

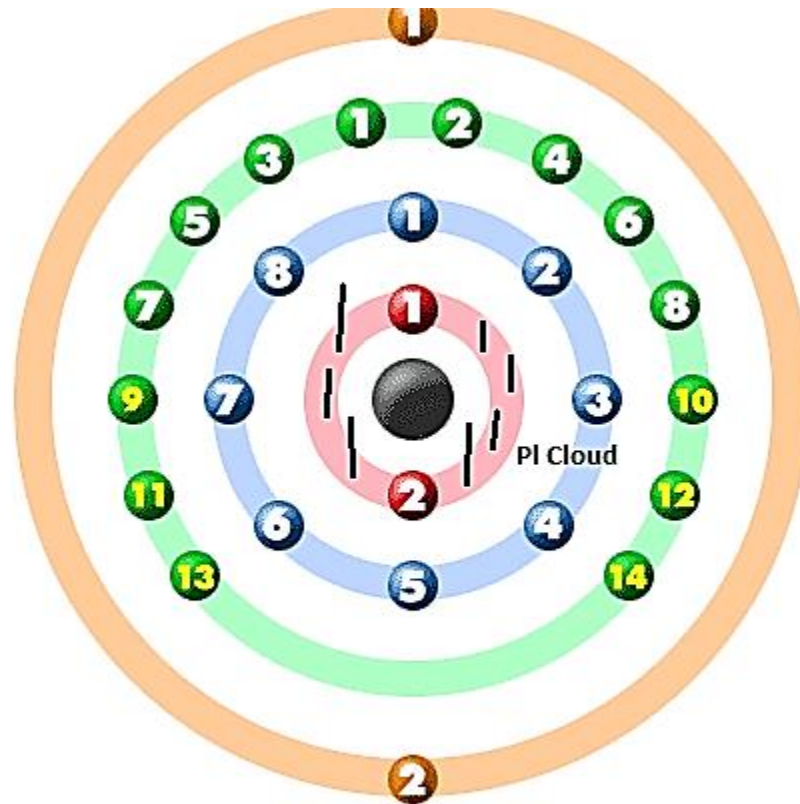


“Contraria non Contradictoria sed Complementa sunt” - Bohr

Takeaway: The particle-wave duality derives from particles being tied to a wavefunction (guiding wave). The particle energy is in the additional dimensions. The guiding Pilot waves are in the 3D dimensions.

6.4 - ELECTRON ORBITS

The “Energy” of an electron is the sum of its rotational bundle clicking (“rest mass”) and its forward motion clicking (“momentum”). To move forward faster, the PLs have to do double time rotating in their configuration, and moving forward, like all matter particles do.

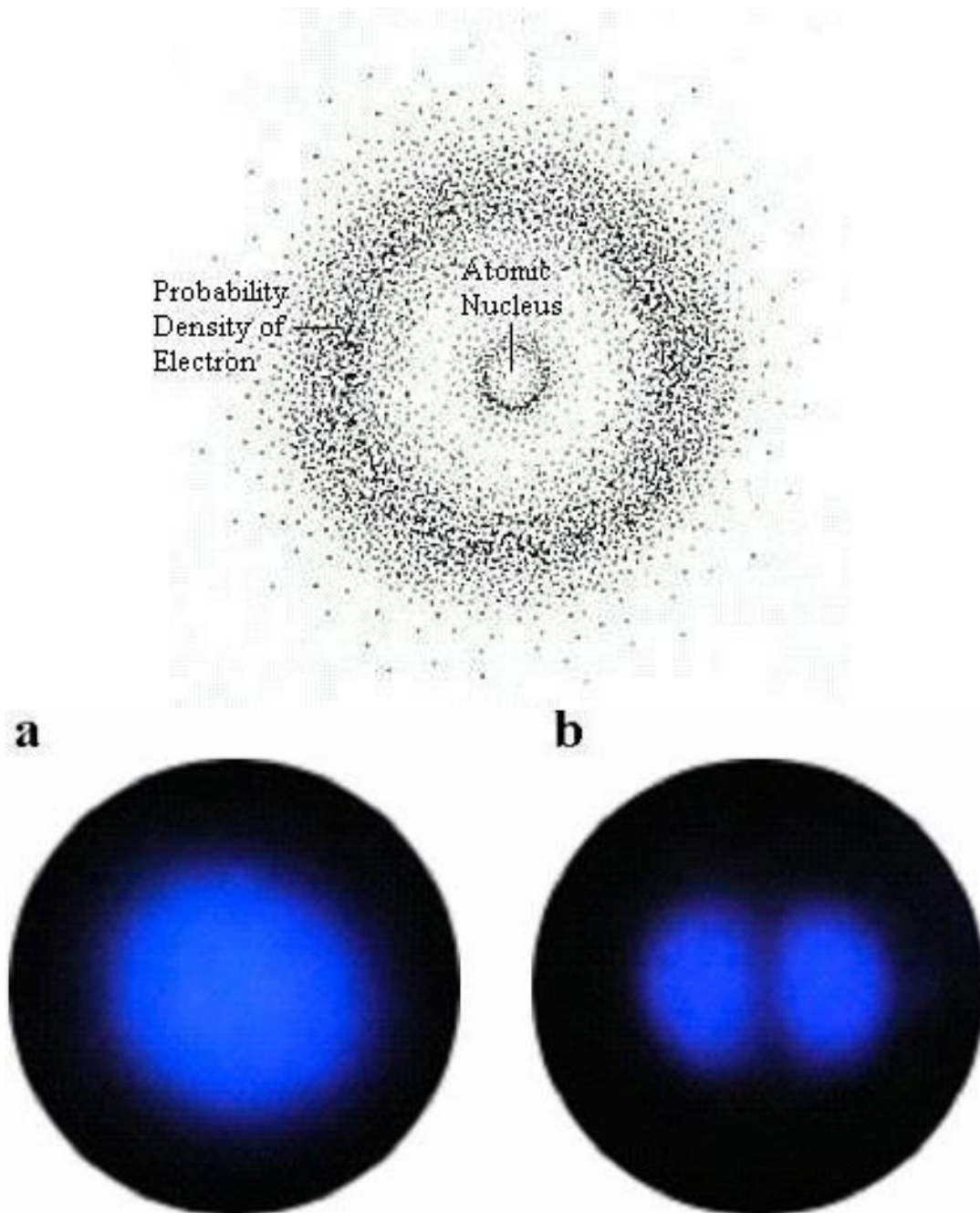


Electron Orbits

The Electron PLCs rotate around the nucleus in harmonic orbits, that allow the maximum correlation of the PLs as they circle the core, basically keeping the rotation in phase. At the same time, their “Pilot” PLs create a cloud in the orbit, providing the “probabilistic” aspect of that orbit. “Each quantum state thus corresponds to a different set of limit cycles and a transition corresponds to an orbit going from one of these to another” (Hiley, Bohm).

A “Jump” from a higher to a lower orbit indicates an entanglement event of the PLC with the lower orbit, causing the jump. The Electron PLC gets rid of some of its PLC “momentum energy” complement, which go out as photons. PLs want to be Free!! That is why lower energy orbits are preferred.

The different energy levels reflect the “momentum” energy to maintain the harmonic level, with minor differences between multiple geometric configurations of the electrons being defined as Quantum numbers. The 2-electrons per level of opposite spin would be a geometrically induced aspect.



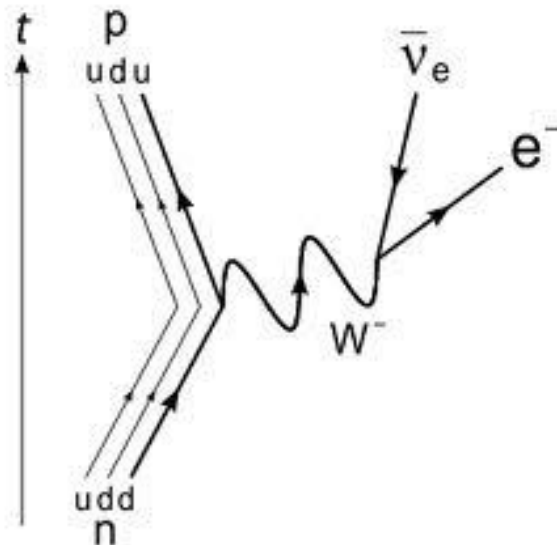
The first detailed images of atoms show various arrangements of the clouds of electrons surrounding a carbon atom. A and B depict two different arrangements of the electron clouds.

Image Credit: Kharkov Institute for Physics and Technology

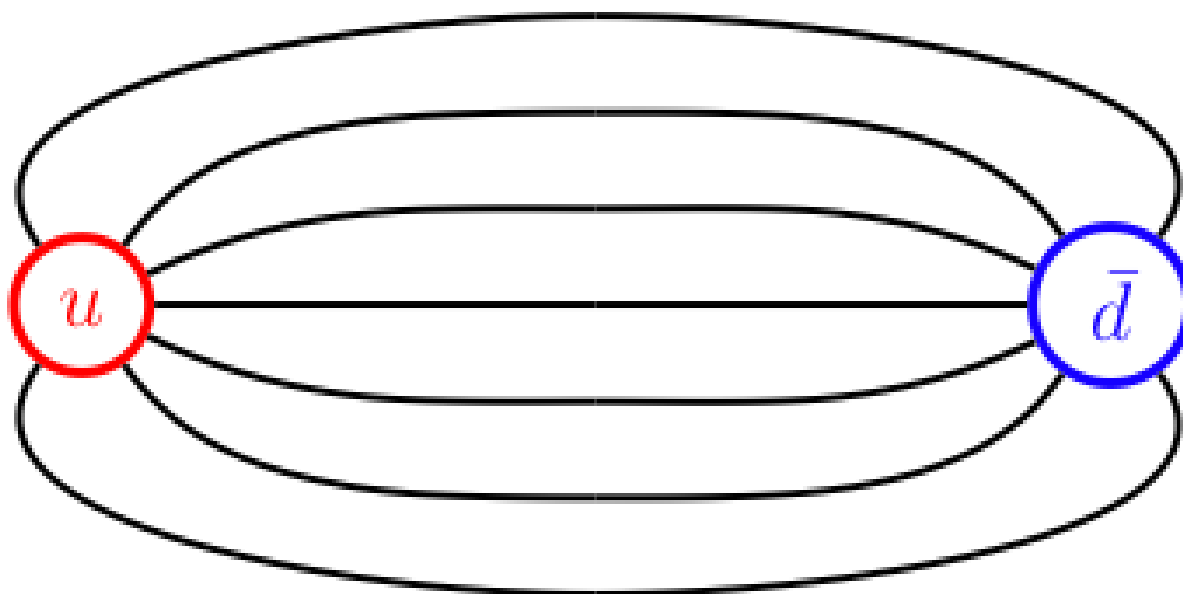
7 - THE FORCES

The four basic forces play out as follows:

- Gravitational Force, being the result of “warps in the 3-D space” (read clustering effect in the Hilbert Space).
- Electromagnetic Force, being a result of a “Force Field” (again an aspect of “warp in space” in the EM dimensions) entanglement between charged particles, the force fields formed by the Pilot PLs. When two force fields interact (Pilot PLs overlap), the corresponding PLCs react, repelling or attracting, this being a geometric effect of the spatially entangled clusters. The strength of this force reduces by $1/r$ squared, since Pilot PL density (basically – space warp) would decrease accordingly with the surface area of the expanding wave.
- The Weak Force, acting at smaller distances, is a tight-algorithm version of the Electromagnetic Force, also a dimensional warp aspect. That is why they “merge” at higher Energies (smaller distances- higher density PLCs).



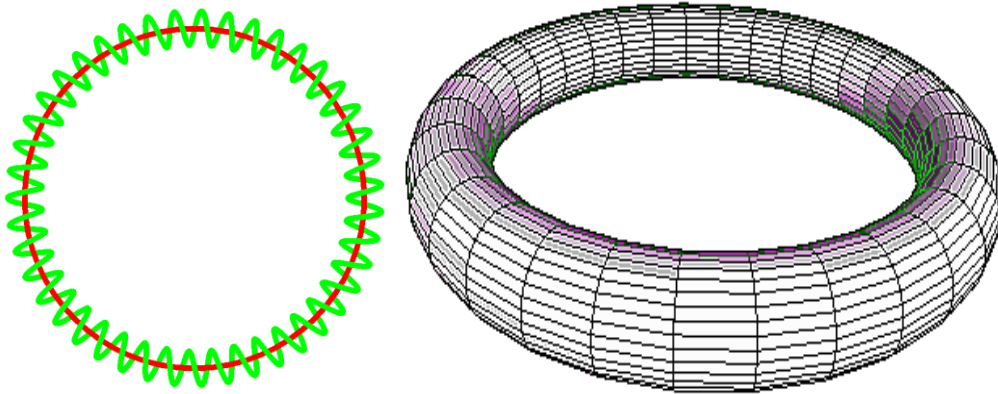
- The Strong Force is a “collimated” Version of the EM and Weak force, the “warp” spreading in a direct line between like PLCs (Quarks). The collimation results from the generation of virtual particles, that anti-screen the color charge, increasing its impact as the quarks separate, resulting in further virtual particle generation, and a higher energy cost, which leads to confinement of the quarks.



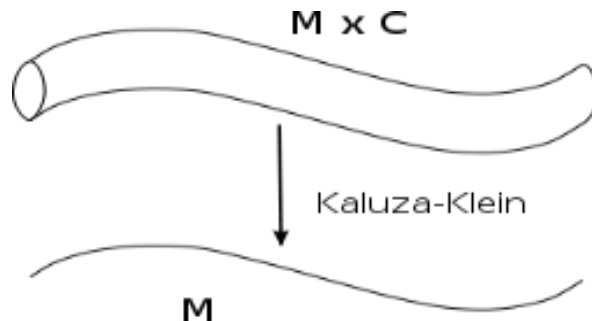
- Again, at very high energies, i.e. shorter wavelengths, the high density of the PLs ensures the three forces above act similarly, unifying their effect. The High density of PLs and PLCs ensures a more uniform dimensional environment, reflecting a higher symmetry (essentially a saturation in the dimensions representing the “charges” corresponding to the forces). As the distances involved get closer to the size of the dimensions of the “charges” (including colors), you get the “equalization” similar to the “equalization” physicists are seeking in the ADD model for gravity. The forces unify as the energy (or equivalently, distances, resulting from increased warp and smaller π / diameter) approaches the size of their color dimensions (which I propose are not planck size), and the oscillating waves become non-linear nuggets.
- It is interesting to notice that the “particles” associated with these forces are usually “massless”, when the force impact is extended over large distances (Photons, Gravitons, etc.), those being “Free” PLCs propagating as waves. The “Weak” Force, with limited range, has “massive” W & Z particles associated, their respective PLC being a resonant PLC and not Free.
- The validity of the “force particle” approach is in question, and the geometric gravitational model is perhaps a better approximation. Black hole charge, mass, and radiation effects are very hard to justify if black holes will not allow EM, graviton or other particles to leave. This is not such a problem with the geometric interpretation.

7.1 - ELECTRO-MAGNETISM

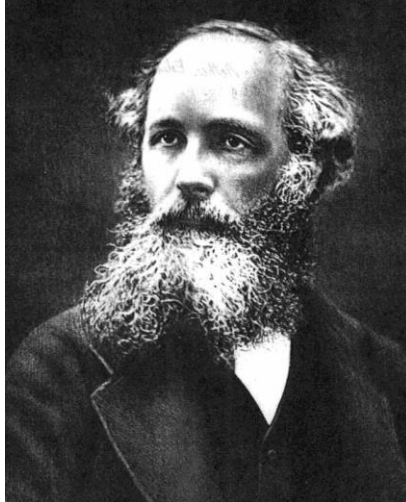
- The particular “geometry” of the electron (a set of Hilbert space correlations of the PLs forming it) presents a “Charge” like property. It could be the trapped Photon configuration presenting a net-charge based on the positioning of the EM “field” oscillations in rotation.



- A corresponding configuration of the positron presents an “opposite” charge property.
- The same goes for all other “charged” particles (Color and Flavor being “Charges” of a different kind.
- A “physical” view would be to conceive of a “Fourth” dimension in the Hilbert Space, with the resultant “Geometry” emulating Electro-magnetism, a-la Kaluza-Klein.

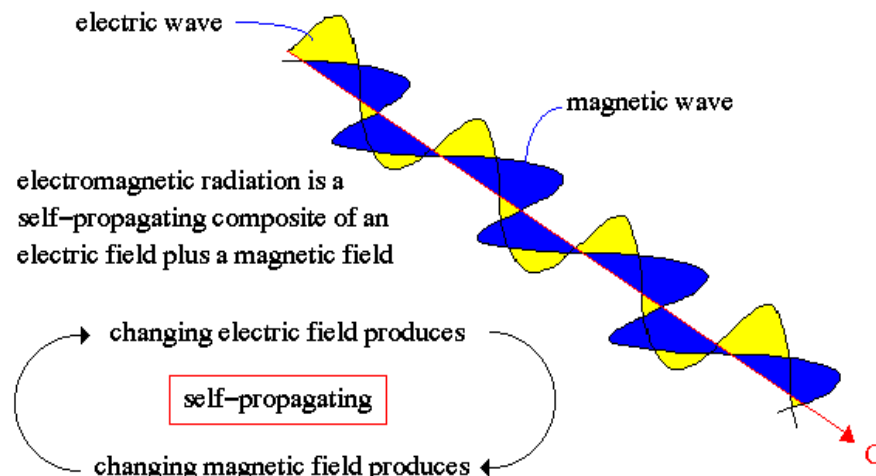


- This geometric “correlation” causing the “charge” would be a particular algorithm created in the Hilbert space between the corresponding PLs. An opposite charge would be another correlation (algorithm of construction) that negates the charge when combined with it. In the case of electron-positron collisions, the two correlations cancel each other, in the process releasing the PLC’s formation to “Free” the PLs, in clusters, called Photons (aka radiation).

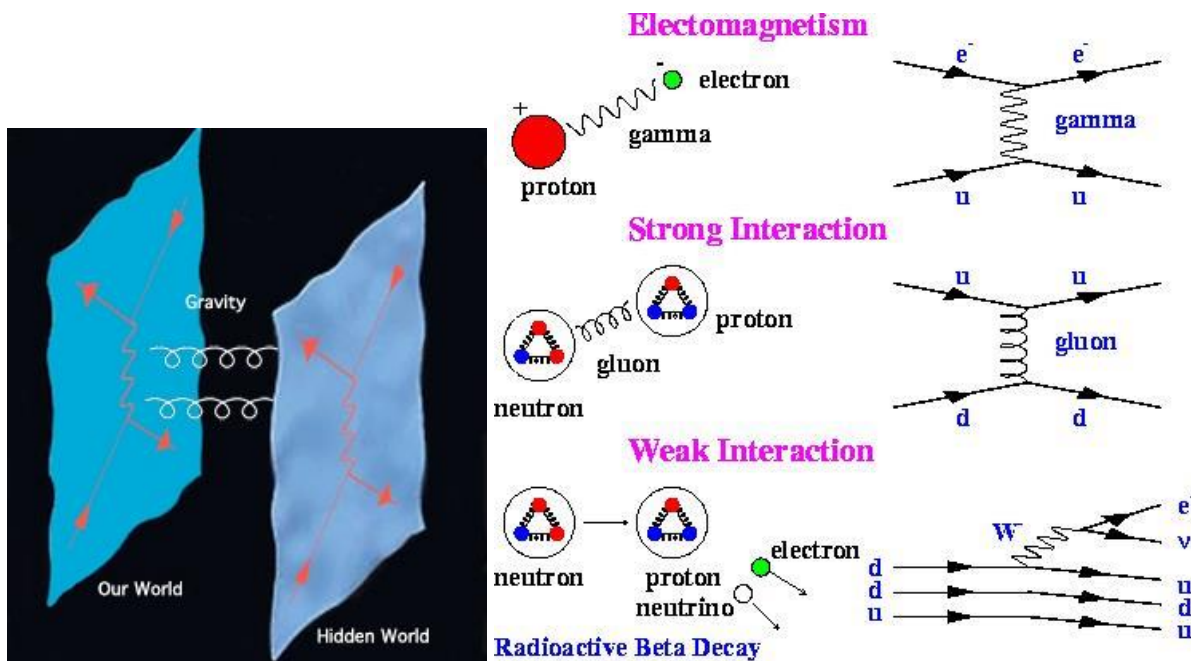


James Clerk Maxwell

- The Electrons or Positrons would dwell in a wave of their own making (through stray PLs spun off, still entangled with them at the Nil-Source). When the “waves” of one electron meet another electron, the Hilbert space correlation “pushes” the electrons to move away from each other... Repulsion. When the waves meet a positron, they push them together... Attraction! The logic seems to be driving for a collision, a tendency to undo the locked correlations and “Free” the PLs. The love of Freedom applies everywhere it seems ☺.
- The “Push” and “Pull” effects are not “forces” (see below), but rather a geometric effect similar to Gravitation in General Relativity, but in specific dimensions for “Charge”.
- The “spin” of the electron formation, would “direct” the stray particles in a particular direction, accelerating a similar effect we recognize as magnetism.



- The picture of alternating electric field changes causing changes in the magnetic field, and vice-versa, together building the EM wave, fits in well with our PL fluid picture, with pressure in one dimension driving a change in a connected (circular?) dimension.
- Bopp's relativistic model for the shape of the EM force around an electron, showing a narrow function of the four-dimensional distance between two points, decaying to the usual $1/r$ function at larger distances, will also fit with our geometric awarp picture, that would be peaked at the high density PLC, and decays asymptotically to $1/r$. Parallels to gravitational fields should be obvious.
- The difference in strength between EM and Gravity, both geometric effects, may easily be explained by the Arkani-Hamed (ADD) and Randall-Sundrum proposals, with the effect of a small (but much larger than planck scale) dimension resulting in the dilution of the gravitational effect. This could explain away the hierarchy problem. It would also explain why the same PL density at a node has a much higher EM effect than the diluted gravitational "mass" effect, the "mass" being an understatement of the PL density due to how it is perceived in the extra dimension. (See also the appendix for a different perspective).



7.2 - FORCES?

“A field of force represents the discrepancy between the natural geometry of a coordinate system and the abstract geometry artificially ascribed to it.”

– Arthur Eddington

As we have indicated earlier, the concept of Force in Dynamics is a dubious idea, a mathematical construct to help “visualize” and “calculate” the effects on particles due to the environment. “Interaction” is perhaps a better word, preferred today in the Standard Model.

Quantum theory reduces all forces to the exchange of tiny discrete packets of energy, while General relativity considers them as “apparent” effects of the distortion of space and time.

Einstein clearly showed that there is no gravitational force. There is no acceleration. “Matter” moves constantly in straight lines, and is not accelerated. The apparent “acceleration” is a visual trick played by nature on creatures used to seeing their world as a Euclidean flat space. The particle, moving in the curved Riemannian space, is moving in a “straight line” (geodetic), a “force-free” action in that (curved) space. It is taking the shortest path, the least action approach. However, the “straight line” of Riemannian space looks like a curved line and an acceleration in our “supposed” Euclidean space. Hence there is no gravitational force, no acceleration – just a warping of space by matter, as General Relativity postulates.

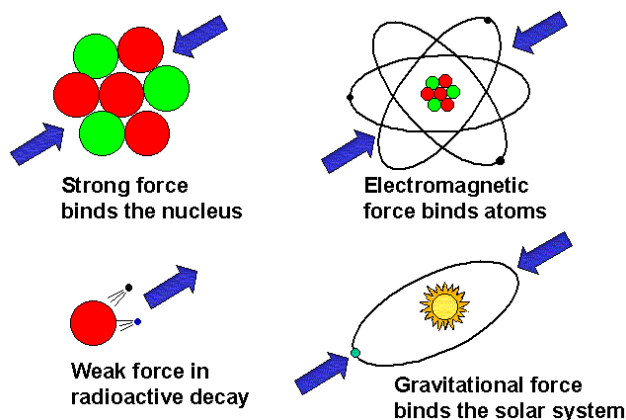
The reason we still talk about gravitational force, acceleration, etc.. and teach it in our classes, is that the Euclidean delusion is stubborn. It has been very useful for our survival. Besides, the equations (and also the intuitions derived from the equations) are easier to deal with, our minds not attuned to curved space, 10-variable Tensors, and non-linear mathematics. Even as we go into the Quantum world, we continue to speak of “Gravitons” and other mathematical crutches. They work, because they emulate the effect. But we should not forget that the “reality” is simply space geometry, the “Grid” or “Mesh” being the primary ingredient of existence, and it is its undulations that present this picture. Gravitational “Forces” are just the result of applying the wrong metric.

William Kingdon Clifford’s insight is vindicated and elaborated by Einstein. Particles are “kinks” in space, and the motions of those kinks is driven by the

geometry of the space (itself affected by the kinks). For Einstein, Infeld and Hoffman, the Particles are “singularities” (of a sort, since not infinite, but peaks and clusters) in the “Gravitational Field”, that field being nothing but “Space” itself, the Riemannian Continuum, where a straight line is a geodesic, and the “natural path” of inertia is that straight line. In a theory of Fields, Force is not a necessary concept. The Gradient of the field, (being the density gradient of PLs), can replace the forces, once we learn to adapt to the warped space trick and adjust our expectation of the geometry of Nature.

When it came to Electromagnetic, Weak, and Strong forces, the gang decided to use another concept to replace force: “Force Particles”, or “Exchange Forces”, with the Photon being the particle for the EM field, the W & Z (Heavy Light!) particles for the weak force, and Gluons for the Strong force. Majorana and Heisenberg started the trend, the math worked, and it remained.

That does not change the fact that it is a mathematical tool, a conceptual mid-wife to describe the phenomena. While the various forces have different behaviours and manifestations, they “all arise from the same Weyl/Yang-Mills mechanism of gauge invariance generalized for the particular multi-component fields of the basic fermions” (Marburger).



Take Electromagnetism, with its almost identity with Gravitational equations (excepting the repulsive character). It would take no Sherlock to expect that it is also a geometric effect, as is gravitation. It just happens in a separate dimension, and therefore looks and feels different, but the same math applies. Finkelstein: “classical gravitational curvature and the electromagnetic field are higher order corrections that remain when we contract quantum event space to a flat, field free, classical space-time” – below a duration of $\hbar/40\text{GeV}$, spacetime concepts break down.

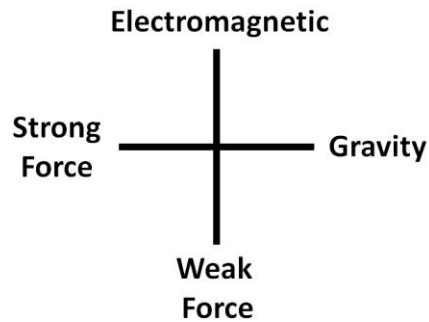
The quantization of Charge is easily explainable by resonant Photon cluster configurations, while the repulsive/ attractive character may be a result of “directionality” (Symmetric/Anti-Symmetric) in the additional dimension (as if the Energy tensor in the Gravitational equations had a negative Energy – something often considered when imagining ways for the repulsive effects causing the accelerated expansion of the Universe). The “Force Particles”, like the Photon, an observed entity, are also a “waving” of that Space. The Electron behaves “as if” it is attracted or repelled, while in actuality making its straight line rounds on the geodesics of this multi-dimensional world, while the “force” behaves “as if” a virtual photon is exchanged. Similar Geometric considerations would also account for the Weak and Strong “forces”, with specific configurations of the extra dimensions resulting in the specific behavior.

Einstein (in “Out of My Later Years”) said: “The general Theory of Relativity is as yet incomplete insofar as it has been able to apply the general principle of relativity satisfactorily only to gravitational fields, but not to the total field. We do not yet now with certainty by what mathematical mechanism the total field in space is to be described and what the general invariant laws are to which this total field is subject. One thing, however, seems certain: namely, that the general principle of relativity will prove a necessary and effective tool for the solution of the problem of the total field.” And if we learnt something the last century, it is that Einstein is usually right- even when he thinks he may be wrong.

The field equations of General Relativity – “God’s Equation” (Aczel) – will serve, in a slightly modified form perhaps, to describe all these forces in their dimensions, as it has successfully described the workings of our Universe & our Cosmology. This iconic equation, a One-Liner crafted by the greatest scientist-magician that ever lived, will continue to revolutionize our understanding of Nature as it has our understanding of gravity.

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

I believe Nature is economical... that it plays its successful tricks repeatedly. We see that in the Matrushka effect of atoms resembling solar systems, solar systems resembling Galaxies, etc. We should see the same economy in Charges, Particles, and Forces.



Interaction	Current theory	Mediators	Relative strength	Long-distance behavior	Range (m)
<u>Strong</u>	<u>Quantum chromodynamics</u> (QCD)	<u>gluons</u>	10^{38}	1 (confinement)	10^{-15}
<u>Electromagnetic</u>	<u>Quantum electrodynamics</u> (QED)	<u>photons</u>	10^{36}	$\frac{1}{r^2}$	∞
<u>Weak</u>	<u>Electroweak Theory</u> (EWT)	<u>W and Z bosons</u>	10^{25}	$\frac{1}{r} e^{-m_{W,Z} r}$	10^{-18}
<u>Gravitation</u>	<u>General Relativity</u> (GR)	<u>gravitons</u> (hypothetical)	1	$\frac{1}{r^2}$	∞

The modern view of the fundamental forces

“The natural laws are not forces external to things, but represent the harmony of movement immanent in them”. - I -Ching

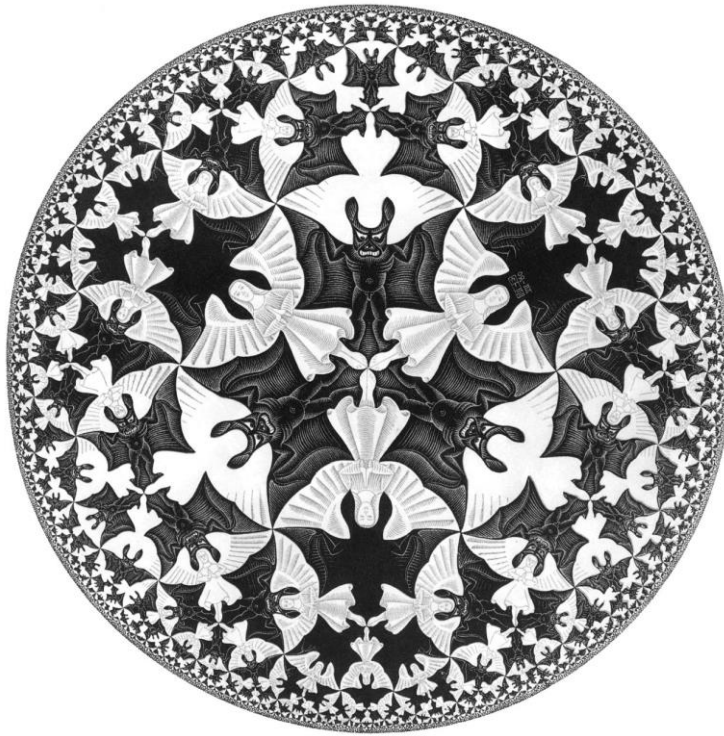
“...the physical theory of relativity has now shown... that electric and magnetic forces are not real at all; they are mere mental constructs of our own, resulting from our rather misguided efforts to understand the motions of the particles. It is the same with the Newtonian force of gravitation, and with energy, momentum and other concepts which were introduced to help us understand the activities of the world – all prove to be mere mental constructs, and do not even pass the test of objectivity.”
– James Jeans

Takeaway: The Forces of Nature are mathematical formulations that represent geometric effects of the Ether, driven by the shape of space as a function of its PL density. Energy in extra dimensions provides different impacts on the 3D space, seen as different “forces”.

8 - SHADOW-WORLD, NETHERWORLD

A word is due on this Nil-Source world of Non-existence.

- If Existence is a logical negation of Non-Existence, then the two are really pretty much equivalent. A PL jumps between two worlds, logical constructs opposed but symmetrical.
- This means there is a “Nether-World” of non-existence, an “Abyss”, a “Dark Side” if you will (if we consider our world the world of Light, PLs). It is Dirac’s “philosophy of NO” (Bachelard).
- This Nether-World (apologies to our Dutch Friends) is entangled with ours, its algorithms and logic a mirror of ours, negative sign notwithstanding.



Escher- Heaven & Hell

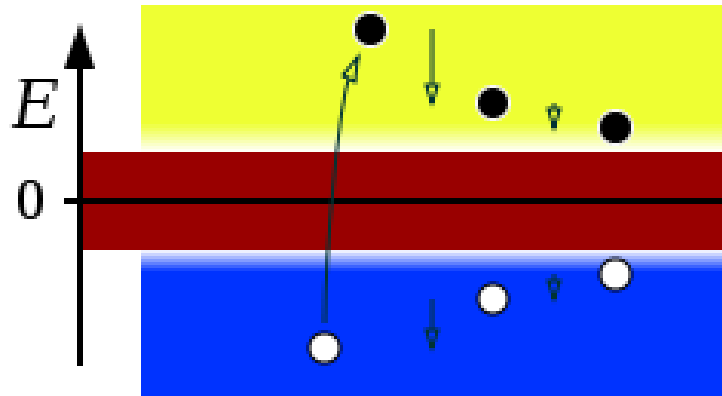
- The mysterious effects of QM are primarily manifestation of this entanglement and co-“existence” (excuse the phrase) of the two worlds. In the NetherWorld there is no time, space or distance, just entangled nil-PLs in a “Logical Space”, the Nil-Source. The Nil-source mirrors the Existence plane’s Hilbert space, without (?) the created PLs and emergent reality it evolved.

- The “Wave function” of a particle or an ensemble is then no more than the algorithm of their “configuration” in the Netherworld. As long as the system is isolated, that Algorithm drives the motion in the Hilbert Space, and provides the “correlation” between the parts. When “Systems” interact, the algorithms interact, split, merge, etc... Depending on the interaction, their Algorithms either merge (Superposition of states- the mystery behind entanglement) or, if the interaction is “destructive” (a solid measurement), they “Decohere” (wave function collapse).

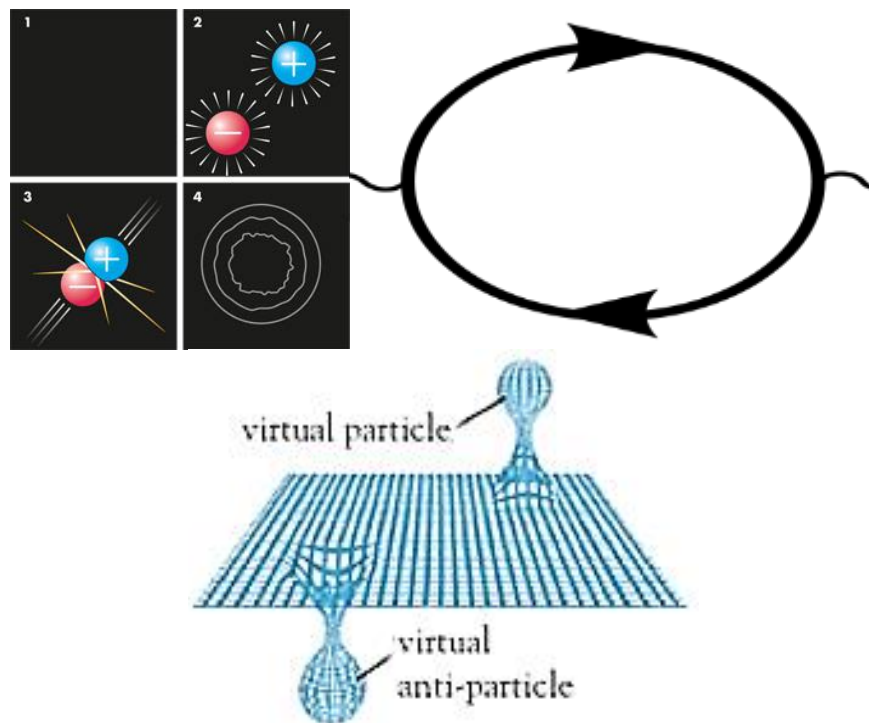


It is the “implicate order” of Bohm. “Particles may be discontinuous in space (the explicate order), but contiguous in the implicate order” (Bohm). “Matter is a form of the implicate order as a vortex is a form of the water – it is not reducible to smaller particles.”

This Netherworld is the purported “Vacuum” that spews out virtual particles. It is Dirac’s Negative Energy sea, which Einstein and others saw as restoring the 19th Century Ether in a strange quantum form. It is Telegdi’s CPT inverted “Anti-world”. Democritus was right, “nothingness exists”.



Rowlands sees it as a kind of super-symmetry, in which the “supersymmetric partners are not new particles, but merely vacuum images or couplings of the original state”.



The Virtual particles are excitations of this vacuum- Netherworld, which are “turned on” by the presence of nearby particles, typically in pairs (maintaining the Net-Zero aspect of creation). In a Superfluid Universe Model, these can be seen as quantized eddies excited by the presence of their more stable “particles” eddies, that appear and then dissipate. Those resonant excitations impact particle properties (like electron bare charge). The Particle exciting those sympathetic eddies looks like it is emitting “virtual” particles and reabsorbing them, as in Feynman’s diagrams and perturbation series, with the

physical picture being the transient eddies. Since those eddies are really warps in the matrix of space, they are effectively projecting the “force” (or interaction) that the particle’s warp in space results in on other particles. Again a Dual way of seeing the same effect, both being a construct of the mind to “visualize” the net result. We can see the repulsion between electrons as either virtual photons pushing them away, or the simple warp in the EM dimension changing their geodesic, the virtual photons being part of the warp.

Other vacuum resonances and fluctuations that persist also create the effect of “Dark Matter” near massive bodies. The Virtual particles, when provided with sufficient energy (read additional PLs), turn into permanent particles. This energy can be supplied by other real particles, or out of the Vacuum (PL creation). Jack Sarfatti sees them as the cause of Dark Matter (virtual fermions) and Dark Energy (virtual bosons), as part of his “World Hologram Model”.

The virtual anti-particles are True negative energy counterparts (as Dirac thought of his negative energy sea), and with the energy-time link demonstrated by the uncertainty principle, their negative energy can be misconstrued as “negative time” or backward travel in time. We know for a fact anti-particles do not travel backwards in time: we have created anti-matter molecules and held them at bay in magnetic traps for up to 17 minutes, and they did not slip back in time and disappear! Modern Field theory has re-interpreted Dirac’s antiparticles as positive energy particles, but both views still apply, and we can still see the anti-particle as the Netherworld negative of the particle. Similarly, virtual particles can be seen as having the same mass as the particle, violating (momentarily) conservation laws, or massless counterparts respecting conservation. Mathematically, the scenarios are identical. Two views to the same scene.

“When the atom and anti-atom unite, is it gravity only that is neutralized, or inertia also? May there not be, in fact, potential matter as well as potential energy? And if this is the case, can we imagine a vast expanse, without motion or mass, filled with this primordial mixture, which we cannot call a substance because it possesses none of the attributes which characterize matter ready to be called into life by the creative spark? Was this the beginning of the world?” – Schuster (1898)

Oscar Klein had analyzed the reflection of electrons at a potential barrier, and concluded they can “penetrate according to the theory [Dirac’s] and arrive on the other side with negative kinetic energy”. This classically forbidden behavior shows the group velocity of the electron wave has a direction opposite to the momentum, which in the classical view would become an “imaginary” momentum. This “Klein Paradox” would remain until re-interpreted as an “anti-particle” phenomenon, but the message is clear. We re-interpret away what we cannot believe. The Klein-Nishima scattering formula would only work if the negative energy states are included. Dirac hinted that “it appears that this difficulty can be removed only by a fundamental change in our current ideas, and is connected with the distinction between past and future”, anticipating Feynman’s & Wheeler’s “traveling backward in time” proposal. Dirac had clearly seen the negative energy solution in the Klein-Gordon equation and in his electron equation, something already present in classical solutions, but always dismissed as “unphysical”.

The Virtual particles and Virtual anti-particles sum up to a true net-zero existence energy. However, since we can only see the positive (existence) energy emanations, we see an average “zero-point” energy that is not truly zero energy. Imbalances in this “zero-point” energy show up as the Casimir effect and other “Vacuum Energy” fluctuations.

“Real” Anti-matter, or anti-particles, are an instance of the anti-particle of the Netherworld “popping out” into existence space, showing its impact in that space by “not being there”! In the Feynman–Stueckelberg interpretation, the antiparticles represent the negative energy modes of the particle moving backward in time. If we stick to a forward time interpretation, we can conceive a positive mass for the anti-particle, while keeping the picture of it as a realized version of the Netherworld particle image. Wigner wisely saw time reversal as simply motion reversal. The negative energy aspect of anti-particles is reconfirmed in Hawking Radiation Scenarios, where the anti-particle that falls into the black hole results in a decrease in its mass – the “backward travel in time” aspect disrupted by the fact that time and space swap roles inside the blackhole. Recent proposals by Hajdukovic from CERN call for anti-matter to be gravitationally repulsive (i.e. negative mass), using this to predict gravitational polarization of gravitational dipoles in the

vacuum, thereby explaining the effect of dark matter and the Tully-Fischer relation. Santilli, as well as Luc Blanchett and Alexandre Le Tiec advanced similar proposal. Experiments at CERN (Alpha- Antihydrogen Laser Physics Apparatus; AEGIS; GBAR) are in progress to test this hypothesis.

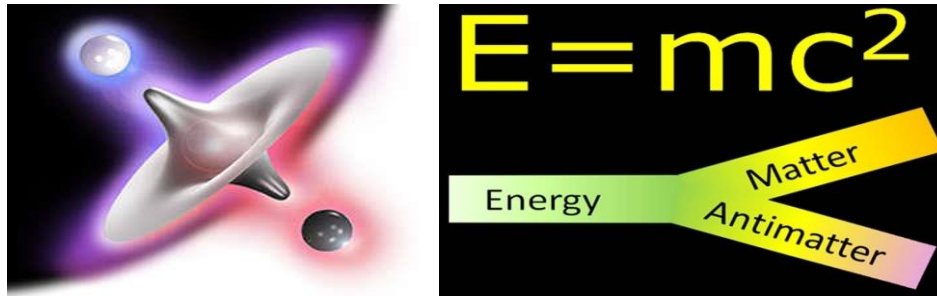
An interesting hint is that Photons are considered their own anti-particles. With Zero Rest Mass, this makes sense, as $0 = -0$. One can also look at the oscillating electro-magnetic field about an axis as swinging between a positive and negative charge regime, i.e. between a matter and antimatter phase, positive and negative energy regimes, as it moves in and out of the existence plane. Hint: Dirac and Pauli had calculated the probability of transition between the $+e$ to $-e$ states as having an order of magnitude of $(v/c)^4$. Now, with $v=c$ for Light, this probability is ONE, a certainty. It means Light would constantly undergo that transition, which it seems to do in its oscillation. This may imply that positive charge reflects a negative energy state, a Netherworld entity, even though we “interpret” it as a different charge with a positive energy. Another interesting aspect: in collisions, the transition probabilities are of the order of α^4 (the fine structure constant), which defines the geometry of electron orbits and relation between charge and mass.

Dirac clearly saw the positron as a negative energy electron: “the holes in the distribution of negative energy electrons are the protons. When an electron of positive energy drops into a hole and fills it up, we have an electron and a proton disappearing together with emission of radiation.” (This was early on when the only positive particle was assumed to be the proton). His wave equations had, in addition to “solutions for which the kinetic energy of the electron is positive, an equal number of unwarranted solutions with negative kinetic energy for the electron, which appear to have no physical meaning”. Dirac, who thought our equations are smarter than we are, knew better. We propose that the equations are right, the energy is negative (even if it can also be interpreted in multiple weird ways, like traveling back in time, etc), and the antiparticle is the shadow particle in the Netherworld, with a negative “non-existence” energy balancing the particle’s “existence” energy. It is the NO to its YES logic, both being real in a sense. A positron “behaves like” an electron with an opposite charge, but it is really much more than that.

“To avoid the unphysical notion of negative-energy electrons, we must pass over to a new interpretation based on the positron theory... The annihilation

of a negative-energy electron is to be understood as the creation of a hole in the sea of negative-energy electrons, or creation of a positron. ... The positron has the momentum $-p$, because an amount p of momentum gets annihilated". "In this way we are led to infer that negative-energy solutions... refer to the motion of a new kind of particle having the mass of an electron and the opposite charge. Such particles have been observed experimentally and are called *positrons*. We cannot, however, simply assert that negative-energy solutions represent positrons, as this would make the dynamical relations all wrong. For instance, it is certainly not true that a positron has a negative kinetic energy. We must therefore establish the theory of the positrons on a somewhat different footing. We assume that *nearly all the negative energy states are occupied*, with one electron in each state in accordance with the exclusion principle of Pauli". It is amusing to point out that Dirac, in trying to avoid those "unphysical" negative energy states, basically filled the world with them- hiding them basically in plain sight! He admitted that "from the symmetry between occupied and unoccupied fermion states..., the present theory is essentially symmetrical between the electrons and the positrons. We should have an equivalent theory if we supposed the positrons to be the basic particles, described by wave equations ... with $-e$ for e , and then supposed that nearly all the states of negative energy for the positrons are filled up, a hole in the distribution of negative energy positrons being then interpreted as an ordinary electron. The theory could be developed consistently with the hypothesis that all the laws of physics are symmetrical between positive and negative charge". In fact, the negative energy states are required and "inherent in any relativistic theory".

Heisenberg even went on to explain the Thomson formula for the scattering of light by free electrons, assuming this "ill-famed" transition from positive mc^2 to $-mc^2$ of the electron, creating an "absorption line" for the electron of $2mc^2$! "Thomson's formula ... just results because of the crazy transitions" (Heisenberg). Crazy or not, that is where the road leads. Pauli's assistant Fierz concluded that classically energy is positive for integral spin, and "indefinite" for half-integer spin. Dirac noted that "the motion of an electron with negative energy is identical to that of a positive electron with charge $+e$ instead of $-e$ ", both classically and in QM. By a slight of hand, you can see the negative energy electron as a "hole" with positive energy and positive charge!



The simultaneous creation of particles/antiparticles from radiation can be seen as follows: the EM radiation is an energy oscillation into positive (“matterworld”) and negative (“anti-matter world” - Netherworld) territory, in the EM dimension, with a net zero mass. When it creates the two particles, the “positive” energy creates the particle, and the “negative” energy creates the antiparticle. The antiparticle is the negative image of the particle PLs in the Netherworld. So what started as zero mass, ends up still as zero mass. No, this does not conflict with our mass/energy conversion rules. It is a matter of semantics, and how you “define” energy. If you define the EM energy as a function of the square of the amplitude $((E^{**2}+B^{**2})*dv)$, then both +/-ve EM directions count, and you get a net positive energy for the EM field. Bohr’s reaction to Dirac’s proposals was that “the fatal transition from positive to negative energy should not be regarded as an indication of what may happen under certain conditions but rather as a limitation in the applicability of the energy concept”. If you consider anti-particles as opposite charge but positive mass travelling backward in time, then you get a net positive mass. Step back, and look at the EM wave as oscillating between positive and negative mass worlds (Existence plane, and Netherworld, respectively), with a net zero mass-energy, creating a positive energy particle and a negative energy image (as Dirac thought), and you have a net zero mass-energy. The “Mass” we observe is all an effect of the vacuum – “a vortex moving with respect to the superfluid vacuum has no bare mass” (Volovik), with “the effective mass ... produced by distortions of the vacuum caused by the motion of the vortex”.

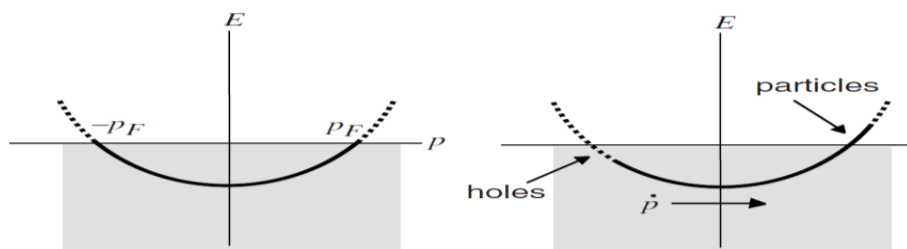
Charmonium, such as the J-psi particle (the hadron equivalent, along with Bottomonium, of positronium (Mohorovicic’s electrum)), is an instant of a long lived (as opposed to the shorter lived mesons) combination of charm quark and charm anti-quark (anticipated by the GIM mechanism of Glashow, Iliopoulos & Malani), showing a slow motion movie of what an electron-positron meeting looks like. The two opposites come together, slowly (because their large mass implies a weakening of their strong force attraction,

due to asymptotic freedom). Eventually they meet and annihilate to release energy, which turns to other by-products again. Think of the J-Psi as an intermediate stage between “matter” and “light”, as the two opposites slowly arrange themselves out of their matter configuration.

Heisenberg clearly stated: “I believe strongly in the hole theory”. A hole is a missing negative energy electron. So a hole has a positive energy! – $-E = +E$! But have you ever eaten a donut hole? The refusal to accept a crazy concept like negative energy drives one to “interpretation”. This “hole” can move around (let us now call it an anti-electron), it can collide (a hole colliding?) with an electron to produce photons. Dirac could find no other way around than to admit that there is a “hypothetical world” where the equations work, and only consider the “real” part of it, even though “it appears to be a better method of interpretation to make the general assumption that transition probabilities obtained for this hypothetical world are the same as in the actual world. ... With photons one can get over the negative-energy difficulty by considering the states of positive and negative energy to be associated with the emission and absorption of a photon...”. He could “build up a form of quantum electrodynamics symmetrical between positive and negative energy photon states”. This **“new Hypothetical world”** “gives the same results as Heisenberg’s and Pauli’s quantum electrodynamics with neglect of the divergent integral” (Dirac). Pauli found this “method of the indefinite metric” “very interesting”, and it was widely used later, including by Heisenberg. Dirac’s “Hypothetical world”, it seems, is real enough. Jim Branson, reviewing Thomson Scattering effects, concludes: “The **“negative energy” sea is required** to get the right answer in Dirac theory. There are **alternatives** to the “negative energy” sea. Effectively we are allowing for the creation of electron positron pairs through the use of the filled negative energy states. The same result could be obtained with the possibility of pair creation, again with the hypothesis that a positron is a “negative energy” electron going backward in time.”

Dirac was adamant: “On my new theory the state of negative energy has physical meaning”. “Negative energies and probabilities should not be considered as nonsense. They are well-defined concepts mathematically, like a negative sum of money, since the equations which express the important properties of energies and probabilities can still be used when they are negative”. Waller used the theory to explain the scattering of radiation by an

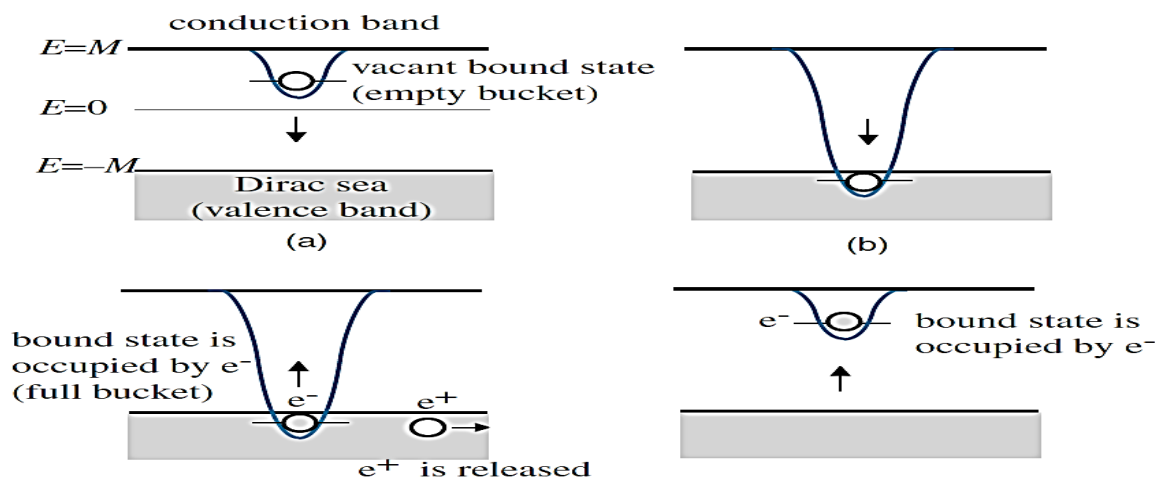
electron and the Raman effect, concluding that the whole of scattering comes from double transitions in which the intermediate state is of negative energy for the electron: if “the states of negative energy have no physical meaning, then one cannot see how the scattering can occur” (Kragh). “Any occupied positive-energy state will always occur with an unoccupied negative-energy state or hole, the two together representing the same physical reality. Thus we get a theory in which the holes of negative-energy distribution are physically the same things as the ordinary positive-energy particles” (Dirac). In his cosmological dickerings, which assumed continuous creation, he proposed to compensate for matter creation with an additional creation of negative mass, unobservable in principle. Weyl even suggested that protons should be described by negative-energy wavefunctions.



The world is neutral at all scales – a Net of Nothing for the cosmos, and for all its components. In this view, charge becomes an indication in its dimension of where the PL is in the existence divide, with zero being the undefinable chaos, positive being existence, and negative being the Netherworld (Hole), where anti-PLs live. (The positive/negative being an arbitrary labeling convention). An X-ray is, in a sense, a “neutral pair of positive and negative electrons” as W.H. Bragg first thought. It is formed when they collide, but more importantly its oscillations (with a net neutral aspect) swing it into the positive and negative “charge” domains, its components being displayed alternately.

Looking at matter, if we see electrons and quarks are rotating Color photons, then their inherent proper “Mass” would also be zero or close to it, since they would also alternate into both domains of positive and negative “mass”. This rhymes with the established fact that the fermions are essentially massless, and get their “mass” from the Higgs field, which one could translate that their dynamics of motion endow them with an “inertia” or “mass” corresponding to their size and configuration. Superfluid theories point to a “Kopnin” relativistic mass component due to the linear response of the momentum carried by the negative energy states of fermions (Volovik, Kopnin). Other

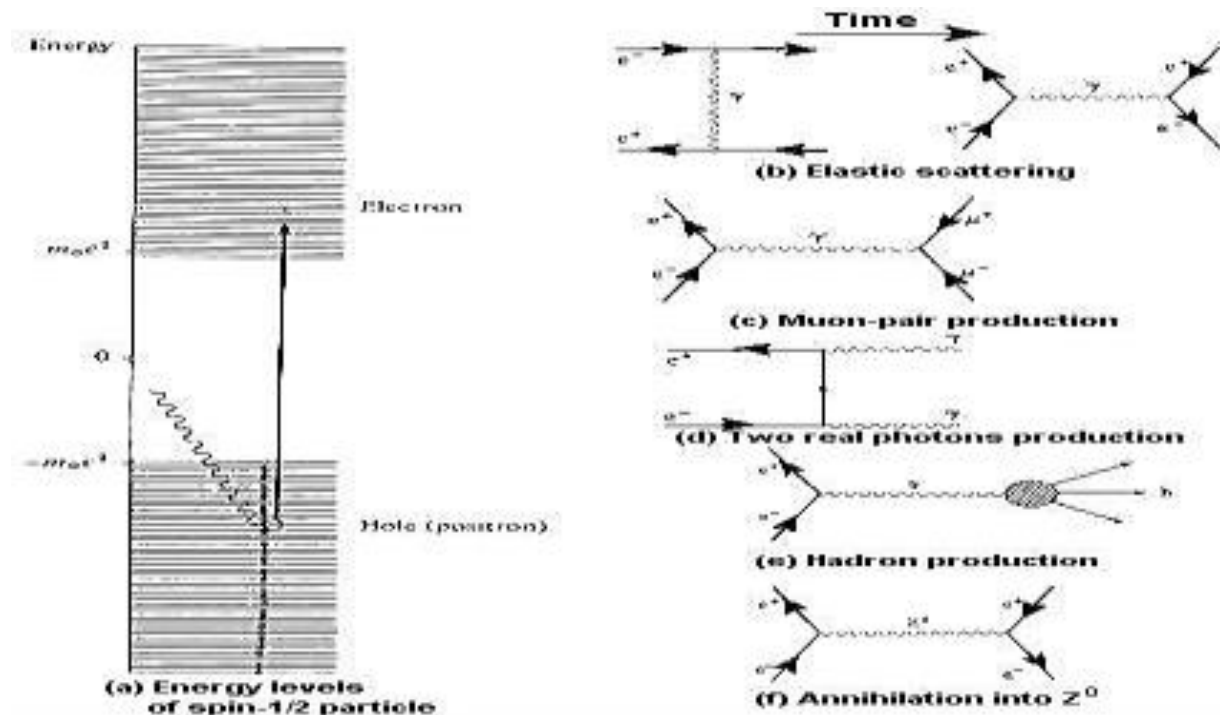
contributions relate to the deformation of the vacuum fields due to the motion of the vortex, primarily an induced “hydrodynamic” mass, tied to the inhomogeneity of the superflow around the particle.



These particles are balanced about the aptly named “Diabolical” (from “conical”) point, exceptional Fermi points in the energy spectrum at which two different energy levels with the same symmetry can touch. It also says that matter and anti-matter are equally plentiful, and present in all things... there is no need for an exotic explanation of the imbalance at the primordial phase causing an excess of matter. Taking the superfluid analogy further, these particles themselves are created as excitations in the vacuum, when the superfluid vacuum flow exceeds the Landau velocity threshold (marking the onset of quantum friction in the otherwise frictionless superfluid), where the doppler-shifted energy becomes negative in the frame of the environment, and “quasi-particles” are created to fill the negative energy states (Volovik).

Antimatter, Arthur Schuster’s (who coined the term) & William Hick’s musings in the 1800’s, Karl Pearson’s Ether “Sink” (compared to matter’s “aether squirts” ☺) of the 4th dimension (where they flow from and into), revises our view of “Not being”. Existence and non-existence are both there, interacting constantly. Our minds see the dance, and interpret it in various ways. It sees the non-being as anti-matter, even imagining it going backward in time. As long as we think in terms of “matter”, we have a hard time thinking on “no-matter”. But as Whitehead, Chew’s bootstrap model and many others have demonstrated, the world is made of “events”, of interacting information. In those events, existence and non-existence are equal players. Transitions out of reality are events as much as transitions into reality. The vacuum is as big a

player as the visible matter. A “Dark Soliton” is as effective as a soliton, the absence of an amplitude as informative as the presence.



We have to extend Einstein’s insights on relativity to new domains – to see that our point of view is as important as what is. How we interpret what we see can make the difference between delusion and seeing the interrelationships of the implicate and explicate orders at play. Oppenheimer and Furry had shown that the creation and destruction operators of QM “are more suitable for turning the liability of the negative states into an asset, by interchanging the role of creation and destruction of those operators that act on the negative states. This interchange can be done in a consistent way without any fundamental change of the equations.” The Destruction of matter of PLs creates anti-matter of Anti-PLs, while the creation of matter of PLs does the reverse. The world is always in balance. We just choose to close our eyes (and minds) and assume it isn’t so: “The consequences are identical to those of the filled-vacuum assumption, but is not necessary to introduce that disagreeable assumption explicitly.” (Openheimer & Furry).

Hermann Bondi had suggested mass might be negative as well as positive, without logical contradiction, as long as the inertial mass, and the active and passive gravitational masses were all negative. Positrons would then be Gamow’s “donkey electrons”, which would move slower the harder you

pushed them ☺. Interestingly, he also pointed out that two objects of equal and opposite mass would produce a constant acceleration of the system towards the positive-mass object while conserving the total mass, momentum and energy. Thought: Could this be the mechanism of motion of Light, with its built in photon/anti-photon components? Robert Forward described “nullification” as what happens when ordinary matter and negative matter meet – they cancel out and “nullify” each other; but this was discounted since any such system with a non-zero momentum would end up violating the conservation of momentum, a classical no-no. Well, what if you ended up with a structure with no mass, and still having a momentum, like, say ... a photon?? Say it looks like two nuggets of positive and negative mass respectively, looking like the two sides of an oscillating wave, chasing each other endlessly? In QED, “the negative energy associated with the degrees of freedom connected with [the scalar potential] A , is always compensated by the positive energy associated with the other longitudinal degrees of freedom, so that it never shows up in practice”, and hence “*there is no longitudinal field energy for states that occur in nature*” (Dirac).

Morris, Thorne and Yurtsever had shown how QM application to the Casimir effect can be used to produce negative-mass regions of spacetime. Even classically, applying Gauss’s law to the gravitational field yields a negative energy density.

The positron is a negative energy electron that parlays its flip effects into the positive energy regime, from the non-existence plane into the existence plane. This “flip” results in a flip of charge, another indication of charge as a twin of mass, both being geometric/logical constructs. The anti-matter we experience is those negative mass components of reality (non-existence) flipped into our plane, while their original mapping (which is symmetrically opposed to matter, as in charge, parity, etc) is maintained. Part of the flip is the apparent “time direction”, and hence why the positron appears like an electron moving backward in time. “The backwards-moving electron when viewed with time moving forwards appears the same as an ordinary electron, except that it is attracted to normal electrons – we say it has a positive charge. For this reason it’s called a positron. The positron is a sister particle to the electron, and is an example of an anti-particle. .. This phenomena is general. Every particle in Nature has an amplitude to move backwards in time, and therefore has an anti-particle.” (Feynman). “And what about photons? Photons look exactly the

same in all respects when they travel backwards in time, so they are their own anti-particles. You see how clever we are at making an exception part of the rule!”. Feynman was clever, clever enough to know that nothing moves back in time, and that apparent backward movement is the signature of negative Energy/Momentum. Energy and time do not commute, and they are intimately tied. Rest Mass Energy and the flow of Time are two sides of a coin. A Photon, which has no rest-mass-energy, experiences no time. Positive rest-mass moves forward in time. Negative rest-mass looks like it is moving backward in time. A Photon, which oscillates between the two states, moves back and forth in time during the oscillation (think retarded and advanced waves), and therefore looks stationary in time overall.

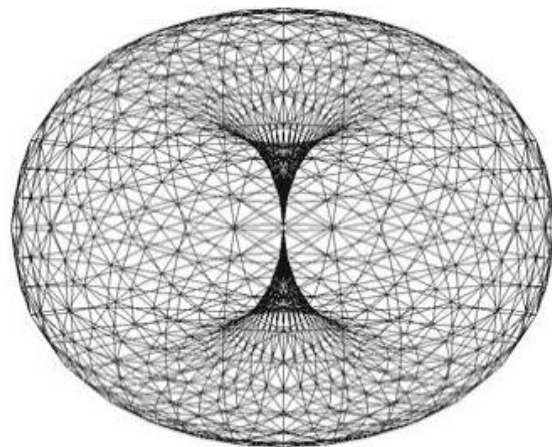
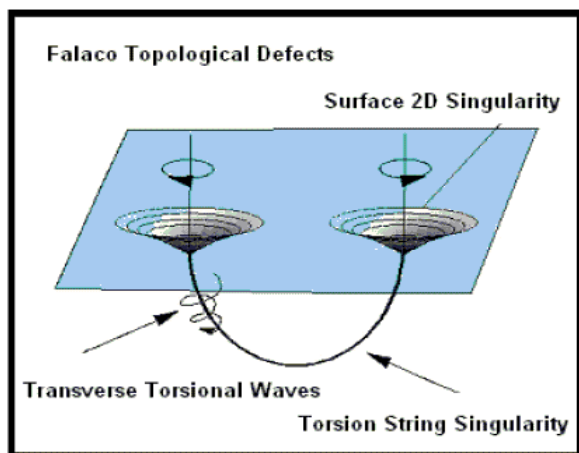
Feynman’s “Advanced” waves in QED are just the anti-matter component of the photon looking like it is traveling backwards in time.

Newton called Mass the “quantity of Matter”. Zero mass then means there is no matter. So what is negative mass/energy? This is then more than just the absence of matter- it is the positive presence of “Non-Existence” logic, anti-matter, the anti-PLs of the Netherworld. Their “presence” at a space node has an effect on the space metric, equivalent to “negative mass” in our formulas, and it displays itself in charge aspects and polarizations. It is a hard fact to visualize, since “the implicit unity of all opposites is extremely difficult to accept” (Capra).

Imagine a photon as an oscillation between “existence” and “non-existence”, positive and negative “energy” or “mass”, resulting in a zero rest mass, and its “energy” observed being a result of its momentum, related to the speed of its oscillation between those two worlds (its frequency). For matter, which is composed of these circulating photons, a “net” rest mass is effected by their rotating structure, including a net “charge” effect, charge essentially reflecting this existence/non-existence dichotomy. Their anti-particles, being the Netherworld reverse image, are the opposite charge and rest mass. This also explains the idea that matter does not have intrinsic mass, but gets its mass from interaction with the Higgs field, which is the E/N boundary field. The weakness of gravity may be a reflection of this aspect of “rest mass” being only the net result of a much larger +ve/-ve mass combination.

Going back to Williamson’s rotating photon electron, many see the twisted turn topology of the photon as evidence the electron has an “inner” positron in

one of the two loops of the photon, echoing our belief that the photon has a mixed particle/antiparticle aspect. The resulting binding between the outer “electron” aspect and the inner (mirror universe) “positron” aspect is what provides the immense binding energy and stability of the electron. The positron is seen to be in a mirror universe (our Netherworld), entangled internally with the “electron” part in its own separate topologically orthogonal space on the “inside” of the doubly twisted ribbon model, but separated from our space via an impassable Rindler Horizon – two flipped vortices linked via a wormhole. The picture “should be “interpreted” as if the positron is an actual electron in that parallel entangled state but seen through a “reciprocal lens” and appears to reside in a reciprocal space in the same way that Fourier Transforms take “optical particles” in normal space and inve a Reciprocal Fourier Space in normal optical systems, the “winding” in this space leading to different quantum numbers” (Physics Discussion Forum; Good Elf; Duffield). The specific topology of Williamson’s photon loop shows a reversal of direction in one of the loops of the velocity of light c , which can be translated to a negative time coordinate , another hint at a “positron” going back in time analogy to Feynman- Stueckelberg.



The electron is seen as a sort of Falaco soliton, “two “dancing” standing stationary waves on the surface of the opposite mouths of the vortex creating the full spin vortex, each one the flip side of the other”. In one way or another, this is similar to Wheeler’s and Einstein’s idea of the electron as a wormhole in space. This electron/positron couplet still looks like an electron in our horizon. The “hidden” positron is a dual on the inside of the doubly twisted model of Williamson, residing in a separate orthogonal topological space – “simply a Conformal Field Deformation of the electron’s internal space” (PDF –

Good Elf). Hints from nature: a positive pion (π^+) is made of one up quark and one down antiquark; and its corresponding antiparticle, the negative pion (π^-), is made of one up antiquark and one down quark. I propose our particle/antiparticle labels refer to the reflection in our space, with much hidden beneath – an anti-proton or anti-neutron may not all be anti-matter.

Gabriel Chardin argued the CP violations in the anomalous regeneration of kaons point to anti-gravity effects of the kaon anti-particles, and used this approach to calculate the expected effect, the results agreeing with observation. It is interesting also that these CP violations are seen by many as the explanation of the matter-anti-matter imbalance after the Big Bang – perhaps a closer look is needed, and the imbalance may not be there if properly interpreted. In another approach, Cabbolet developed the “Elementary Process Theory” to derive the anti-gravitational character of antimatter.

Massimo Villata argues, based on CPT invariance grounds and General Relativity, that anti-matter should repulse matter, acting as if it had negative gravitational mass, *“as if antimatter were matter “living” in a totally inverted space-time”* (read our Netherworld). Antimatter is space-time-reversed matter! While the gravitational repulsion may be seen as the result of an effectively negative gravitational mass, we can also think of the mass remaining positive, and the negative sign coming from the PT aspect (after all, something coming towards you in negative time is really going away from you! – this is Feynman/Stueckelberg’s interpretation, but that is what it is, an interpretation). But for a Newtonian limit, and since we subscribe to a single direction for time, the negative gravitational mass assumption is easier to grasp. In both cases, the gravitational “charge” for anti-matter is negative. An anti-apple would not have fallen on Newton’s head on earth, but would have bumped anti-Newton on anti-earth. Cabbolet has challenged that view, seeing our spacetime as one, which all entities obey in the spirit of General Relativity (geodesics, etc) – but gives an out: if anti-particles see a different metric than ours (ordinary particles); this Villata already assumes in his inverted spacetime.

Villata and others see in this as a potential justification for cosmological models attempting to explain the observed accelerated expansion of the Universe as a repulsion between equal amounts of matter and anti-matter.

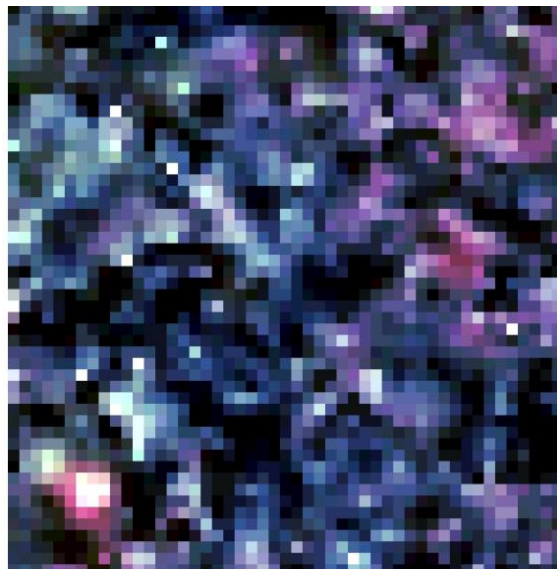
“The gravitational repulsion would prevent the mutual annihilation of isolated and alternated systems of matter and anti-matter. The location of antimatter could be identified with the well-known large-scale (tens of Mpc) voids observed in the distribution of galaxy clusters and superclusters. Indeed, Piran showed that these voids can originate from small negative fluctuations in the primordial density field, which (*acting as if they have an effective negative gravitational mass*) repel surrounding matter, and grow as the largest structures in the Universe”. A good question: “If large-scale voids are the location of antimatter, why should we not observe anything there?” is left unanswered. Ruggero Maria Santilli has an idea.

Santilli has developed a full ISO-Dual algebra, that postulates an inverted space-time (our Netherworld), built upon identifying a Negative Unit identity – essentially our anti-PLs, a negation of the positive fields in our “matter” world (our existence field). By applying the usual algebraic rules, commutation, etc, “all quantities which are positive-definite when referred to fields (such as mass, energy, angular momentum, density, temperature, time, etc.) became negative-definite when referred to isodual fields”. However, since they are referred to a negative-definite unit $I < 0$, there is “a mathematical and physical equivalence between *positive-definite quantities referred to positive-definite units, characterizing matter, and negative-definite quantities referred to negative-definite units, characterizing anti-matter*”. Santilli goes on to build an iso-dual Euclidean, Minkowski and Riemannian geometry, including iso-dual light cones emitted from anti-matter. By characterizing anti-matter with this iso-dual mathematics, all characteristics of anti-matter change signs as compared with matter. This solves one of the outstanding issues with QM, allowing first quantization of anti-matter, currently relegated only to second quantization, unlike matter, allowing an equal treatment of both. It also resolves the issue with current gravitational theories handling anti-matter vienergy-momentum tensor, while electro-weak theory characterizes them via negative energy states. As a result, antimatter, in the fields of matter, experiences anti-gravity (a reversal of the sign of the curvature tensor). Iso-dual particles (antiparticles) also emerge with a negative time, as dealt with in the Feynman-Stueckelberg approach. The result is “a mere *reinterpretation* of Dirac’s original notion of antiparticle, while leaving all numerical predictions under electroweak interactions essentially unchanged”.

The ideas “turn out to be deeply linked to pre-existing studies. As an example, the parity of antiparticles originally introduced by Bargmann, Wightman and Wigner, when expressed in the recent formulation by Ahluwalia, Johnson and Goldman, turns out to be equivalent to isodual space inversions”, with the isodual approach acting on a *new* inverted spacetime (our Netherworld) built the Negative Basic Unit (our anti-PL). “... trajectories of antiparticles may *appear* to exist in our space while in reality they may belong to an independent space, the isodual Euclidean space, coexisting with our own space”. The new mathematics simply models known existing physics, by interpreting it in a new light. Actions and forces, like the coulomb force, are computed by “*projecting the antiparticle in the conventional space of the particle or vice-versa*”. As such, “*particles with negative masses and energies referred to negative units are fully equivalent to particles with positive masses and energies referred to positive units. ... time moving backward referred to negative unit is fully equivalent on grounds of causality to time moving forward referred to a positive unit*”. Relativity still applies, “based on *negative units of space and time*”, with a negative $-c$ speed, while leaving invariant the fundamental space-time interval of SR. The solution accommodate our gauge theories, which admit positive and negative energy solutions, to gravitational theory, which now only deals with positive energy states, by providing an anti-matter that has a negative-definite energy-momentum tensor, paving the way for a closer unification. In fact, the similarities then between electromagnetism (with its positive/negative, attraction, repulsion) and Gravitation become more evident, Newton’s laws then fully mapping into Coulomb’s laws, as geometric constructs, and furthering our view that both result from the same source, with EM being also the source of mass.

Santilli works out this identification of EM and Gravitational fields in a model of the π^0 meson, which “thought its total electromagnetic data are null, this particle is made up of two opposite charges in very high dynamical conditions with respect to each other”. The results lead to a match of EM energy with the rest mass, and the correct gravitational field impact, including the contributions of the weak and strong interactions. He uses a little known Freud identity (used also by Pauli) to show the π^0 has a “nowhere null” source even though it has a null total charge and multipole moments. To his credit, Santilli insists that the proof will be in the pudding, pushing for experimental verification of the anti-gravity effects of anti-matter, and acknowledging arguments against it by Morrison, Schiff and Good, and others. As an aside, he

mentions the possibility of anti-matter meteors, with the Siberian Tunguska explosion showing signs of such an impact. Since his model also includes isodual EM waves with negative energy (something we dispute, assuming light as already a mixed entity), and such light would go FTL in matter (inverse refraction), he has built and tested concave lenses to try to photograph potential anti-matter galaxies, with some interesting results, his anti-matter light showing dark images (due to negative energy of anti-Light) potentially representing anti-matter.



In our view so far, it looks like positive charge is the external aspect of antimatter (Telegdi: “charge conjugation C (replacing the world by the antiworld, being careful to mean by charge all charges and not only the electrical one”). Hint: positrons. So is a proton actually antimatter? No, because the essence of a proton is not just the charge, but its quark constituents, which are in the matter world. But its charge may be a reflection that it harbors within its structure a positron-like entity, with the corresponding anti-matter aspect and negative mass. Hint: a proton weight about one electron less than a Neutron, which doesn’t have that component! We already know that “the difference in energy among different nuclei ...multiplets should be accounted for mostly by the electrical charge difference between protons and neutrons, not by the strong nuclear force” (Marburger).

Quantum field theory deals with anti-matter by creating a charge-conjugate *antiparticle* field, with its own creation and annihilation operators (which act as the anti-operators of the corresponding matter-particle fields). I see this as

our Netherworld field, the conjugate charge element corresponding to our idea that charge oscillations correspond to dips into that field. In QFT, the Hamiltonian H (representing energy) need not be positive. The anti-particle field has the opposite charge and sign for energy compared to the particle field, with the vacuum state defined as the state with no particle or antiparticle.

“Feynman diagrams are a pictursque shorthand for performing calculations without getting bogged down in the profound machinery of quantum mechanics where charged particles interact with electromagnetic fields. They enable us to compute the answers; they keep track of the subtle pitfalls in accounting for positive and negative energy states; thinking of the latter as ‘backwards in time’ is very useful for avoiding some of these pitfalls but nothing, so far as we know, actually travels backwards in time. Just as electrons are negatively charged, positive energy particles moving forward in time, so are positrons their positively charged analogues, also with positive energy, and also moving forwards in time” (Frank Close).

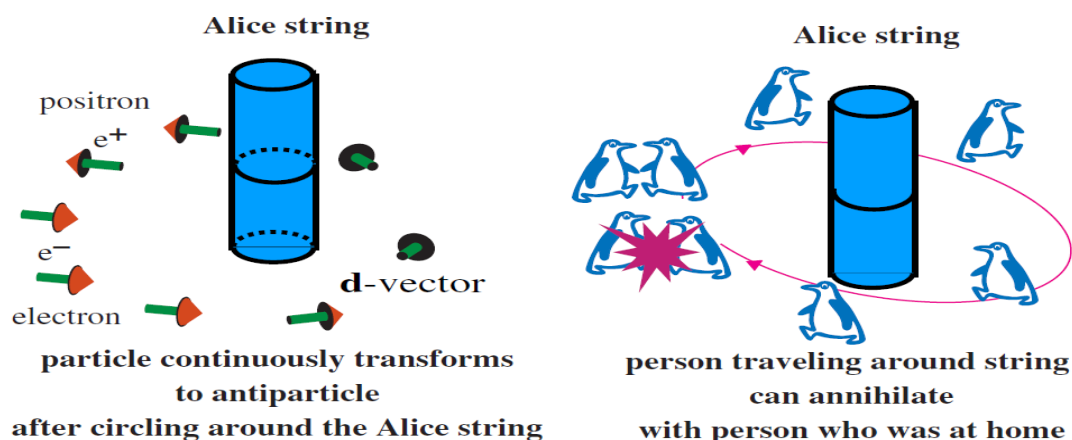
This Netherworld is then real, and its effects are manifest in our everyday lives. Its Yin transforms into our Yang, in constant flux. Antimatter in the Netherworld looks like it is moving backward in time, with negative Energy/mass. “Whether matter and anti=matter behave symmetrically under the influence of gravity is the subject of debate” (Close). All of our “particles”, photons, electrons, etc, are a mixed bag of both, with the antiparticle hidden in the inside geometry. The Universe is not just net-zero overall, but also zero everywhere.

By the way, NASA & CERN calculate that it would cost 25 Billion Dollars and billions of years to generate one gram of anti-matter, which they can only hold for a maximum of 17 minutes! NOTHING costs a lot of money to make.

When protons and anti-protons interact, they exchange “pomeron”, hypothetically a nugget of energy consisting of quarks and gluons but in a state with the properties (quantum numbers) of the vacuum. A proton can emit a pomeron while remaining intact! I think we need to look at the interaction as being a re-alignment between the positive and negative energy states of the proton – anti-proton pair, perceived as a “pomeron” entity – our mathematical picture not catching up with the ontological view.

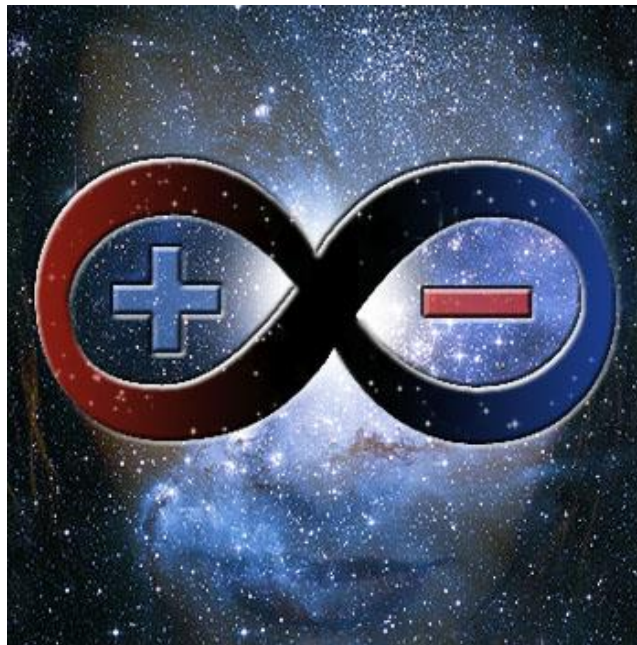
In S-Matrix theory, ***crossing*** is the property of scattering amplitudes that allows antiparticles to be seen as particles going backwards in time – with the energy being negative for the anti-particle! Ingoing particles become outgoing anti-particles by crossing. Anti-particle scattering amplitudes are the analytic continuation of particle scattering amplitudes to negative energies. You can interpret it (like Physicists now do) as the antiparticle being a particle going backwards in time, OR you can accept the negative energy of the anti-particle (as our ontology allows). In this view, the creation of a particle of momentum/energy p cannot be distinguished from the destruction of an anti-particle of momentum/energy $-p$.

Antonino Zichichi insists “Not only real but imaginary masses exist. The existence of imaginary masses has an important effect on our description of the vacuum. In turn, the vacuum determines the masses and interaction properties of real particles”. “The imaginary masses play a central role in physics”. He lists their understanding as one of the Ten Challenges of subnuclear physics. He lists “superfluidity and superconductivity as examples of effects which are produced as if an imaginary mass was there”. “An example are the Cooper pairs which enter into the Lagrangian as if a particle with twice the charge and negative mass was there. Superconductivity exists, but the particle with double-negative electric charge and imaginary mass is not there”. I say it is there, in the Netherworld, outside our “existence space”. Zichichi also lists “confinement” and “monopoles” as effects generated by the existence of imaginary masses, which also generate massless photons in $SU(2)*U(1)$. Wigner had noted that “it proved to be necessary for the definition of the position operators to extend the original Hilbert space, referring only to positive energy states, to include also negative energy states”.



Other potential candidates for our mystery are the “Mirror particles”, or Mirror Matter, postulated by R. Foot, H. Lew and R. R. Volkas. While not detected yet, the theory postulates a partner to each particle with a “mirror image” parity, that could explain parity violations in the electroweak theory, and possibly explain dark matter as “mirror galaxies”. Could these be effects of the image in the Netherworld being displayed in reality, as anti-matter possibly is? Could this “Shadow Matter”, or “Alice Matter” be “the other side”?

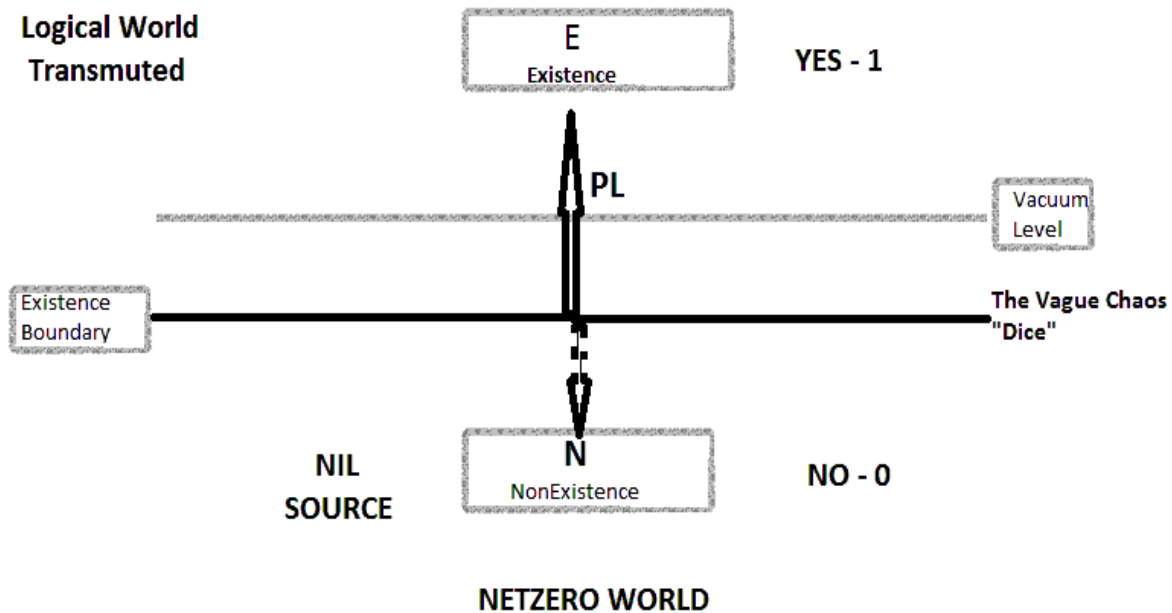
Could the Alice Strings, which cause particles to flip charge or polarity, moving it into the “shadow world”, be the Gateway to this world? [In Superfluids He3 simulations which emulate our Superfluid Universe, a Half-quantum vortex with a Mobius geometry can simulate the effects of an Alice String. Such Mobius geometry can also connect two separate worlds across a vierbein wall without crossing it, tying normally relativistically disconnected domains, providing superluminal communication between them and the effects of coherence via analytic continuation and particle currents across the vierbein walls (Volovik)]. Speculations, but such is life at the frontier.



Takeaway: The Netherworld is the negative image of our experienced existence plane. In that sense, it can be seen as the negative energy/negative mass that shows up in many of our equations, and that we use to explain many phenomena. In that sense, it is also a part of our world, visible by its absence as much as our world is visible by its presence.

12.2 - "NETZERO" WORLD

The "Nil-Source" world has two guiding rules: (1) Correlate and synchronize the PL world and (2) Maintain the total "Nothing" of being and non-being – Keep the balance.



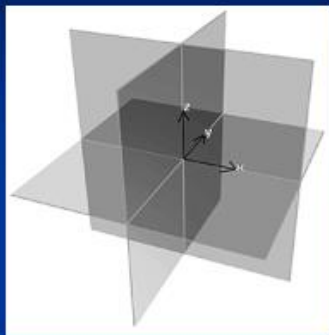
- Nature seeks its Net-zero balance from which it starts, the vacuum oscillations resulting in a zero-sum game. The World starts as **logical** emptiness – an unsustainable condition. It is the "Chaos", the vague state between Being and Not-Being... That is when the "Dice" are tossed.
- Non-existence, when said that way, implying non-being, is misleading- Wittgenstein complained about the limitations of our language and how it drives our thinking. In a Logical world, the NO is just as significant as the YES. Non-existence is a Hilbert space of NO in itself, the "NIL-Source" where existence falls back into as it clicks into and out of the "being" state. That Nil-Source space could be as complex as the Existence space, and would be the source of entanglement, wave probabilities, and other correlations.
- The rules of the game seem to be that Existence Space and the Nil-Source should balance; clicking into E followed by N, a NetZero game. For an observer in the Existence space, we would see an average E state, that we would call the "Vacuum" Energy, but from a Logical perspective, the Net is Zero, E being balanced by N. N would represent TRUE

Negative Energy which we do not see in our E world except as “anti-matter”, the “Negative” energies we talk about in the Dirac sea, which are simply below the Vacuum level, in the N zone.

- The four defining parameters we see, Time, Space, Mass (Energy) and Charge (of all kinds), demonstrate this effect. Mass and Charge, being manifestation of the “existence” property (Mass being its definition, Charge its relationship and interaction), are necessarily conserved (to a zero cosmic sum). Space and time, being instantiations of the propagations of matter and the causal relationships ensuing, are infinite and unconserved.

The 4 Fundamental Resources

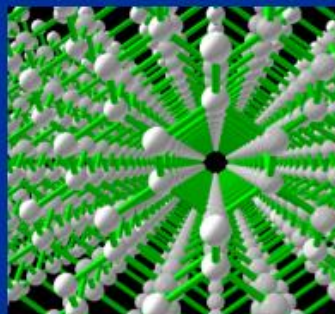
Space



Time



Matter



Free
Energy

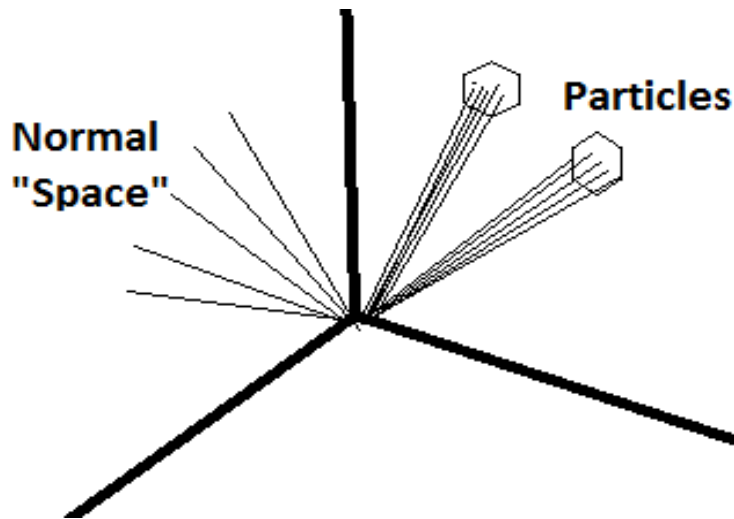


12.3 - HILBERT'S EXISTENCE HOTEL

"I am a part of all that I have met"

Alfred Lord Tennyson, *"Ulysses"*

The PLs being created form a Hilbert space in the infinite dimensional "nowhere" they find, and from their correlations create the space we see.



These PL points will move around the space, obeying certain rules, following a mathematical logic in their own logical space, translated by the PLs into existence. Their behavior not much unlike a gas, their relationships and formations changing, but still obeying some statistical rules that give their end result a semblance of order – Einstein, Bose and others studied light as a “gas” of radiation particles, with some outstanding results. More generally, the various proposals for “pre-geometry” provide ways to define the interactions in this Hilbert Space, leading to our classical view. (QM already defines wave functions in Hilbert Space, & superpositions are linear combinations in it.)

- As in most spaces, it is easiest to move into an adjacent node. When the PL does that, repeatedly, it “draws” space, forming the straight lines we know, producing light, and creating the Euclidean space we know and love.
- When the points cluster together in a common spot, their assembly creates a vortex, a “particle”, an agglomeration of PLs that forms photons, Electrons, resonances and such.
- A Cluster density would tend to diffuse either in unison if highly correlated (particle), or separately if not. A mixed-mode would have a

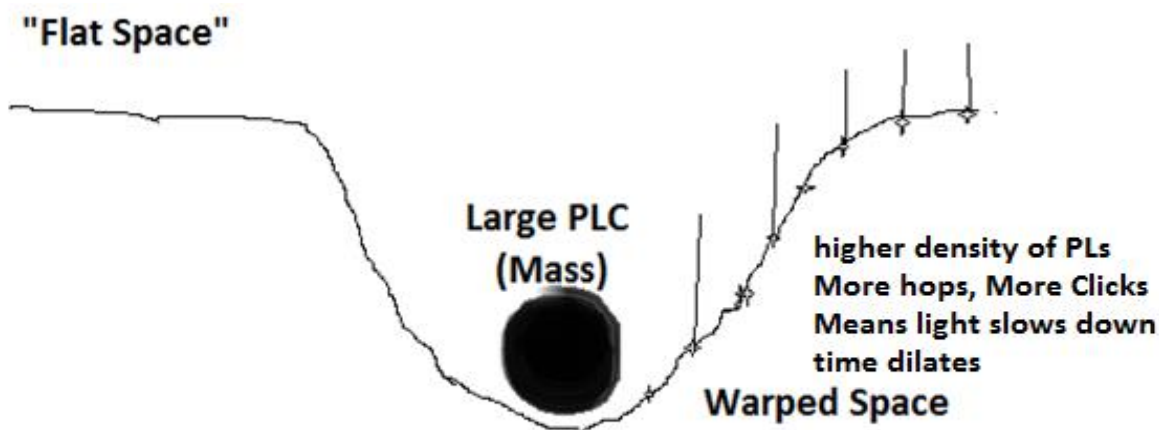
cluster move in unison, with renegade PLs spreading independently while maintaining an entanglement with the core, creating a “Pilot wave” phenomenon that sends out feelers from the particle everywhere, driving the particle-wave duality we see. Those stray “Pilot” PLs would also form the “Fields” we see in Electromagnetic and other interactions, their entanglement with the source ensuring the continuing link and common effect. This is the “Virtual Radiation Field” of Slater, that enables “Communication” between distant “Particles”.

- The “Particle” and its con-committant Pilot waves parallel a field with a singularity, as Einstein thought, with the total energy localized in the Singularity. The “fields of force” of the Pilot PL waves provide the undulatory interference aspect of “particle” interactions. These are the “electromagnetic fields” in “empty space” of Lorentz, driven by the position and velocity of the “point charges” located on the material particles (the Singularities). This Dualism between point and continuum, particle and wave, struck Einstein as intriguing, but the clue did not lead further at that time. He hoped that a theory would show the world a field, the particle being merely an area of special density of field-energy, and the disturbing dualism would disappear.
- The diffusion and clustering of these points is driven by the rules of logic, given their binary nature- adding, multiplying, commuting, etc – a convergence of mathematics and physics in a digital world.
- When modeling this behavior, many lessons should carry over from thermodynamics and statistical mechanics. Our experience of many phenomena (Black hole entropy, temperature, etc) should enforce this concept.
- While the “rules” of our universe eventually force stability in a three-dimensional space, nothing prevents this Hilbert space hotel from having separate rooms – independent three dimensional compartments or existence domains, being separate worlds of their own, unlinked to our world, except in the Nil-Source domain. They may not be out of our reach, if only we knew how to cross that barrier.
- Black-Holes, the ultimate clusters, started in our “world” (read domain), warping space such that their PLs cannot move outwardly, could force the PLs to spawn a new domain, creating a world separate from ours “elsewhere”. The idea of Black-Holes spawning new Universes is virulent in our modern cosmology.

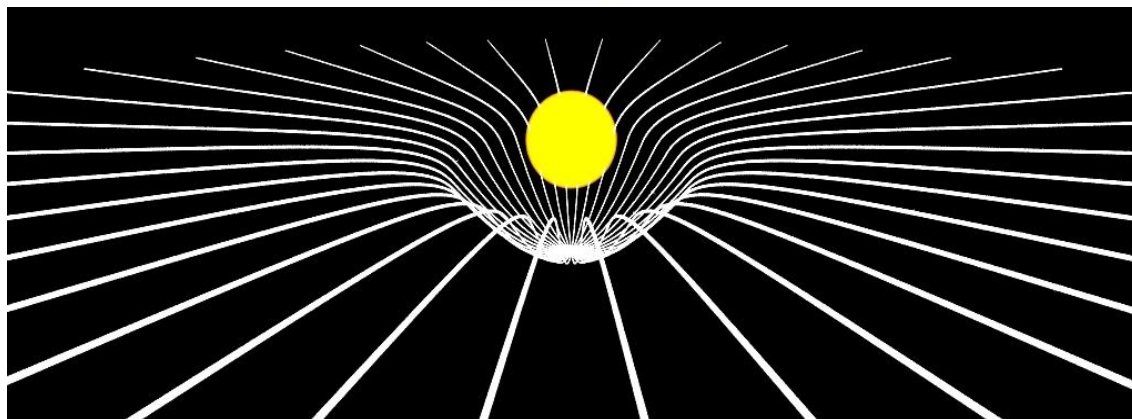
9 - GRAVITY

"There's a certain irrationality to any work on gravitation, so it's hard to explain why you do any of it... the correct problem is what determines the size of gravitation?"

– Richard Feynman



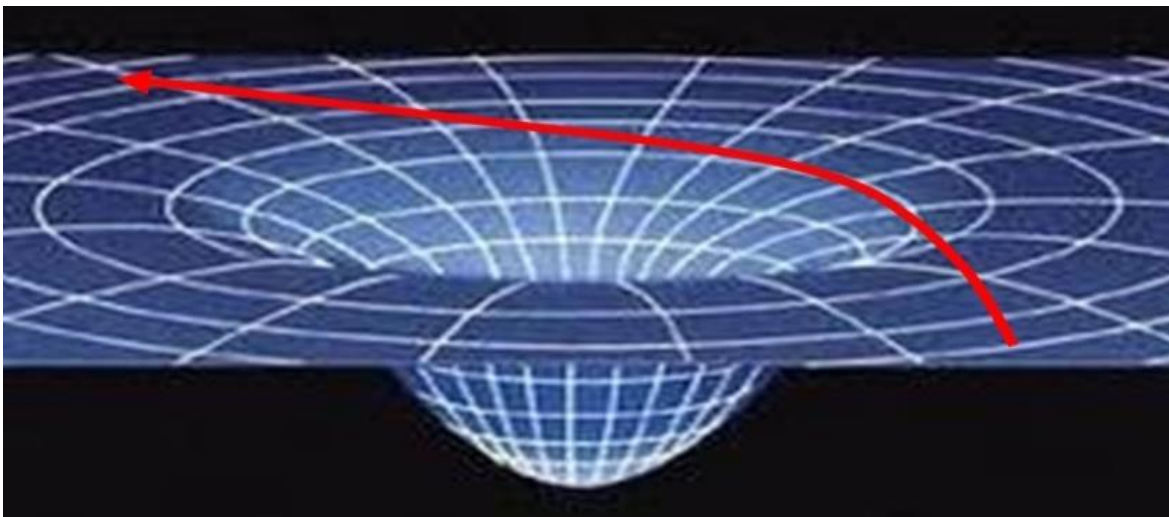
Gravity



- The formation of the Particle bundle (matter), a cluster in the Hilbert existence space, would present itself as a "warping" of our perceived "space", with Matter/ Particle clusters causing increasing warp in the logical/perceived space, the warping leading to the concept of Gravitational attraction, and hence the concept of "Mass".
- "Warp" represents an anomaly in the "uniform" Hilbert space that normally represents our "Flat" space. The "Heavy" (read dense cluster) PLC accentuates the correlation with neighboring PLs (like fluids in a trubulent flow, forming vortices (a-la-Descarte's swirling ethereal vortices universe ("tourbillons") of "second matter" or "second element"

& Huygens' vortex theory) around a solid obstruction- again nature repeating its games at all scales), so their successive "moves" will tend to cross more nodes (in the same "distance" in the Hilbert space). This has the effect of (1) decreasing the "apparent" distance between points (acceleration), "squashing" space, and (2) More clicks to cross the nodes, stretching "time" so to speak, effectively slowing perceived "Time" (Dilation). The resulting space warp and time dilation would simulate General Relativity's gravitational effects. Einstein had suggested "it is indeed quite possible that gravitational fields constitute an essential part of *matter*".

- Basically, in the "warped area", there is more Space/ Space Nodes – a higher space "density", than in an equivalent "unwarped area". More Nodes to cross (from a Euclidean perspective), so the "distance" looks longer to a traveling cluster, and takes "longer"-more clicks. The Shapiro effect of Light taking longer to travel in curved space results.
- The Warp of Gravity would offer a "refraction"-like effect, as Eddington thought. PLCs moving, avoiding areas of cluster, taking the path of least effort (action), leads to the same perceived effect, resulting in the slower speed effect and bending of light. The "bending" thus of light would seem like an attraction, which we read as gravity.



- From here on Einstein takes over, and General Relativity applies. A moving photon would follow the "straight line" of nodes it sees, effectively following the warp nodes. A PLC (particle) in the neighborhood would also move towards the massive PLC, its PLCs following the warped node structure (sliding "down" the warp). Gravity

equates to Acceleration, both resulting in PLCs passing nodes at a faster rate.

- A point to consider is made by van Flandern: Curved Spacetime, the essence of GR, does not necessarily mean curved space. Misner, Thorne and Wheeler had indicated “if there was one reason more than any other why Riemann failed to make the decisive connection between gravitation and curvature, it was this: that he thought of space and the curvature of space, not of spacetime and the curvature of spacetime.” Throughout this book, I speak of curved space for ease of visualization, but what is curved is spacetime, mainly through the local slowing of time- the clock slowing down at (1) higher speeds and (2) high gravitational potentials. Both of those effects are explained in our PL model as (1) skipping time beats for a moving body, since motion in space cancels the clicks in time of the PLs, and (2) the higher gravitational fields reflect a higher density of PLs (clustering), and hence a higher number of dense nodes to cross in the same “apparent” (Euclidean) space, effectively slowing down time.
- Gravitons would be the virtual propagations of “ripples” in the “shape” of the space fabric, carried throughout all space by the distortions of mass and energy. Looked at another way, the Graviton represents the gradient of the warped space, resulting in a change in nodal “distance” between adjacent nodes.
- Gravity Waves would represent the undulations in the space structure as it tries to re-normalize (i.e. as the Hilbert space nodes re-diffuse to a uniform state). Since the undulations change the PL distribution, this manifests itself in the “Energy” of the PLs varying with the wave, forming the gravitational wave energy field. Gravitons and Gravitational waves are emergent features from the space oscillations (Hilbert Space correlations instability).
- Our PL solution also resolves another issue raised against GR with gravity as Geometry, and not a force. Even on a curved surface, a particle initially at rest would not “roll” unless something pushed it- so how does the motion and acceleration happen in the first place? Our PL picture of matter as an EM phenomena, with PLs “born” skipping nodes at the speed of light, means that matter is always in motion (as rotating photons for matter, or as energy in traveling photons), and hence curved space will affect its rotation and direct it to “move” accordingly.

Gravity, Gravitational waves, and time dilation in a gravitational “field” are geometric features of the PL cluster effect on the Hilbert Space configuration. The waves are ripples in the geometry. Max Abraham’s initial theory of Gravitation saw a new ‘ansatz’ for a ‘hydrostatic pressure’ of the gravitational field. A black hole is a sink-hole in the geometry. “Gravitational Energy” is not the same as other types of Energy – it is “potential” energy, a sort of negative energy representing the tendency of the Hilbert matrix to want to return to a uniform (unwarped) configuration. It is in a sense the “negative” energy that, when added to the “energy” of matter/EM (meaning the warp in energy and matter) gives us the net-zero energy of the Universe, meaning the flat uniform space. (Interestingly, Abraham found the gain in kinetic energy when masses approach each other was only half of the loss in potential energy, concluding that the gravitational field also contains energy). This tendency, or “negative” energy, provides the Universal aspect of inertia for mass (and similar effect for charges), in line with Mach’s principle, with mass and charge reacting to the total “vacuum” background structure. The gravitational constant can be seen as a measure of the ‘metric elasticity of space’ (Sakharov). Our PLs, the zero-point energy of space, are the “sausage meat” that fills the empty sausage skin of space, to borrow Wheeler’s flamboyant imagery.



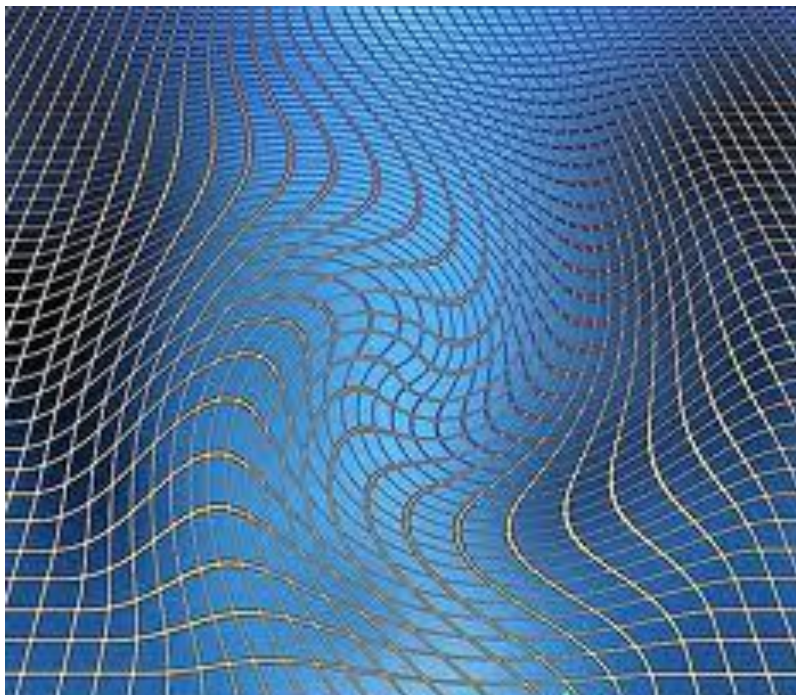
Since time & space are conjoint (“time” being the clicking between the “space” nodes), then those are effects in the “space-time” geometry. “Distance” changing between nodes is gravity. Time slowing down at different places is gravity. A simple geometrical effect brings unity to these diverse concepts. If we view the space-time manifold as a Riemannian *intrinsic* geometry embedded in an *extrinsic* Euclidean embedding space, we can visualize how

the straight lines of the warped Riemannian manifold look like curved paths in the extrinsic space, and understand better the “effects” of gravity. Many see Gravity as thermodynamics, from which its equations can be derived, and “gravity on a macroscopic scale is just an average of the behavior of some still unknown “atoms” of space-time”.

Early on, Wien had concluded that if we assume the mass of a body is an electromagnetic mass, then there has to be a proportionality between EM energy, inertial mass and gravitational mass.

An interesting point to ponder: Navy experiments (by Flandern, Hoffman), including the Alley experiment, show that clocks are not affected by acceleration. Cyclotron experiments (even at 10^{19} G) show acceleration does not affect clock rates. How this meshes with the equivalence principle is to be clarified.

“Matter tells space how to curve, and space tells matter how to move.” – John Wheeler



The Shape of Space

“The Poor get Poorer and the Rich get Richer” – Yakov Zel’dovich, explaining Gravitational attraction.

“Comrade, how dare you ascribe the laws of capitalism to the whole Universe?” – Soviet Communist Party

8.1 - FIRST SINGULARITY

"In the beginning there was nothing – which exploded" ☺

– Terry Pratchett (Sci Fi writer)

"Our Universe is simply one of those things which happens from time to time"

– Edward Tryon

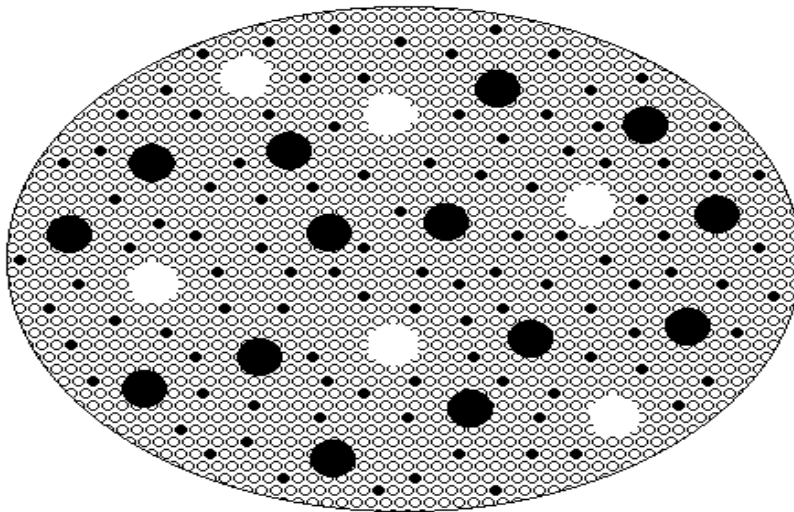
In the beginning... "Let there be Light, and there was Light"

- The "First PL" would have been a lonely existence in a sparse "place" it created out of nowhere.
- The "Next PLs", also coming from nowhere, could:
 - Create their own nodes, or
 - Use the node created by their elder brother; forming a very tight Hilbert space
 - If they cluster at the same node, a very high "density" of PLs would accumulate at that "point", creating a "Singularity"
- This Singularity, which causes mathematical contortions to many, is not problematic when you think about it. The "Energy" density in space is inapplicable- It is Energy at that point, which has no "size", not even zero, space being defined post-facto by the relationship between subsequently created nodes – It is still "Nowhere". The only thing the singularity signifies is that the initial PL batch was highly "correlated" or "clustered" in its binary properties... The Universe was at that point simply "additive", other relationships not yet established.
- In the Singularity itself, PLs are not "moving"... so time (their clicking) does not exist... it stands still. Since only a single node exists, there is also no "space". No space, no density, no infinity – just a countable arbitrary set (additive) of PLs. In one form or another, this is Lemaitre's 'unique atom ... the totalmass of the universe' - "Primeval Atom", or Hawking's Instanton.
- At some point (figuratively), another node would pop up- The space logic developing "associative" properties besides addition. Now the PLs have somewhere "else" to click... "Space" is being created, and the initial cluster starts to disperse, creating space in its wake... Bingo! - or rather Big-Bang! "The big bang is a bit bang. Starting from its very earliest moments, every piece of the universe was processing information" (Seth Lloyd).

- The initial high density and its spread would account for the shenanigans of the “First Three Minutes”, as the decreasing density of PL clusters allows the creation of the “particles” described above in succession, the rest of the scenario following the classic Big-Bang story, Dicke’s “Fireball” model. Lemaitre’s “brilliantly clever *jeu d’esprit*” is incredibly prescient about this scenario, inflationary scenario, decelerating phase, and accelerating universe included – “the most beautiful and satisfactory explanation of creation to which I have ever listened” (Einstein). While other plausible scenarios can be drawn in a PL world for the current state of the Universe (including Alfvén-Klein models of Plasma Cosmology), the Big Bang approach seems to best explain the abundance of heavy nuclei and Alpher & Herman’s ‘divine creation curves’, and has stood the test of time, including the recent detection of Gravitational waves in the CBR (the BICEP-2 experiments), verifying inflationary theories and discrediting Ekpyrotic and other models.

Spacetime Foam

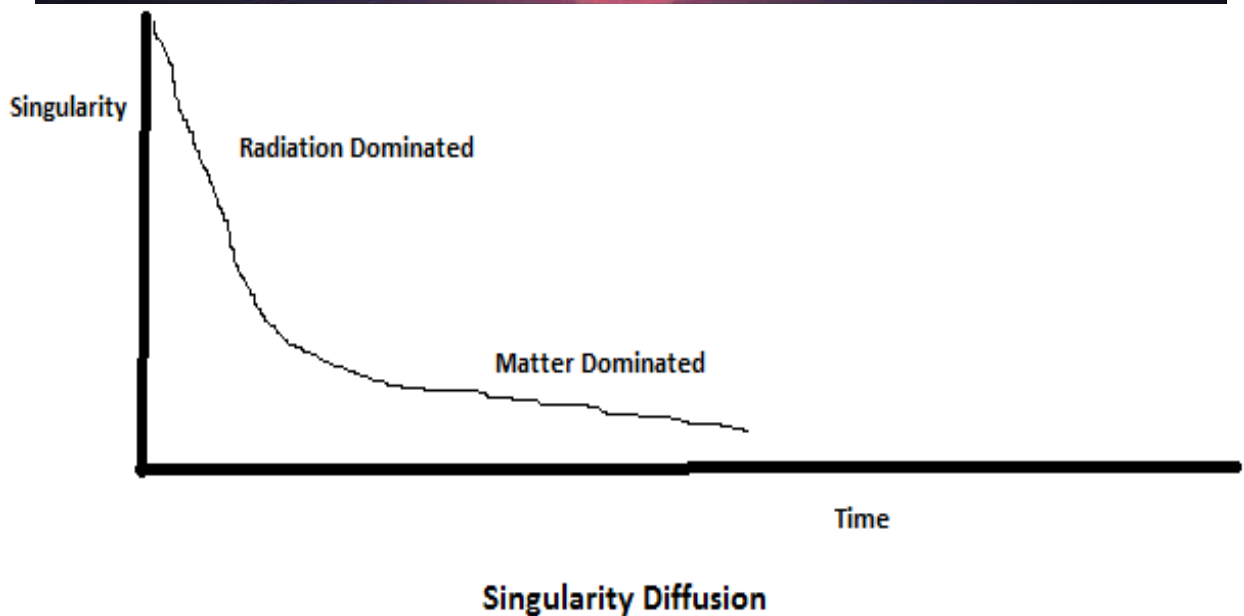
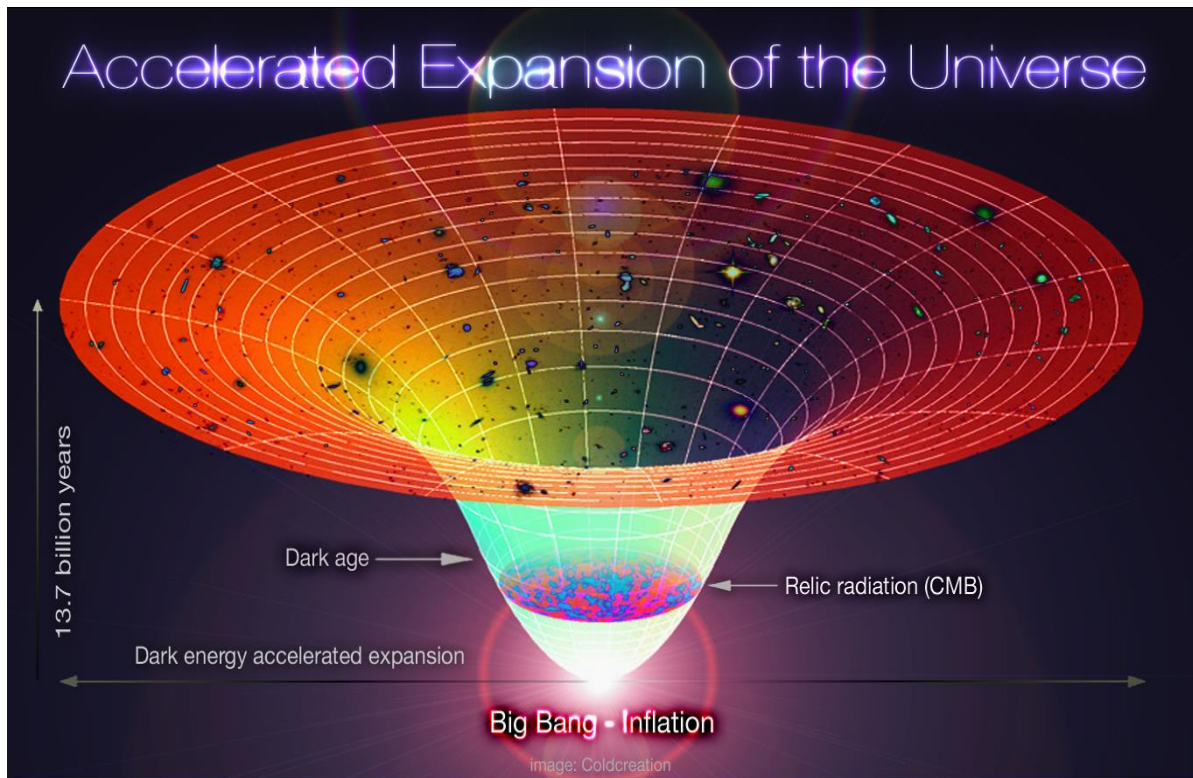
the immediate era after the Planck time is one of pressures and densities so high that spacetime itself is folded and meshed into foam of mini-black holes and wormholes



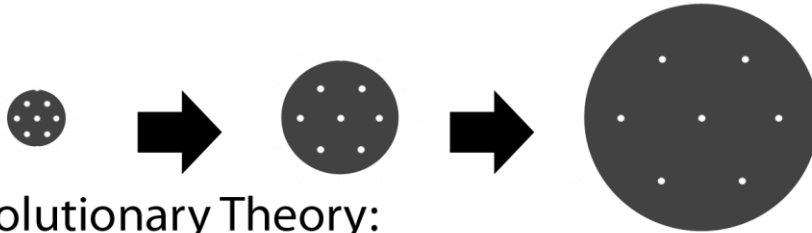
although the Planck time marks the beginning of time in the Universe, the convoluted nature of spacetime in this early phase, with numerous singularities and overlapping event horizons, makes it impossible for matter, photons or even causality to exist

- This would also explain the “Inflation” of Alan Guth, since a higher Initial Energy would drive an accelerated push to create nodes and return the

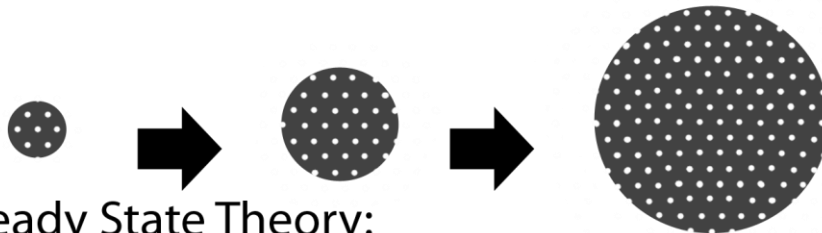
E level to its “nothing” state. Once “normal” E levels are reached, space expansion continues through the normal creation-ex-Nihilo process we have today. The photons created in the first phase still dance around in the Cosmic Background Radiation (CBR) that gave Penzias and Wilson their accidental Nobel Prize (“Either we’ve seen a pile of bird s**t, or the creation of the Universe”).



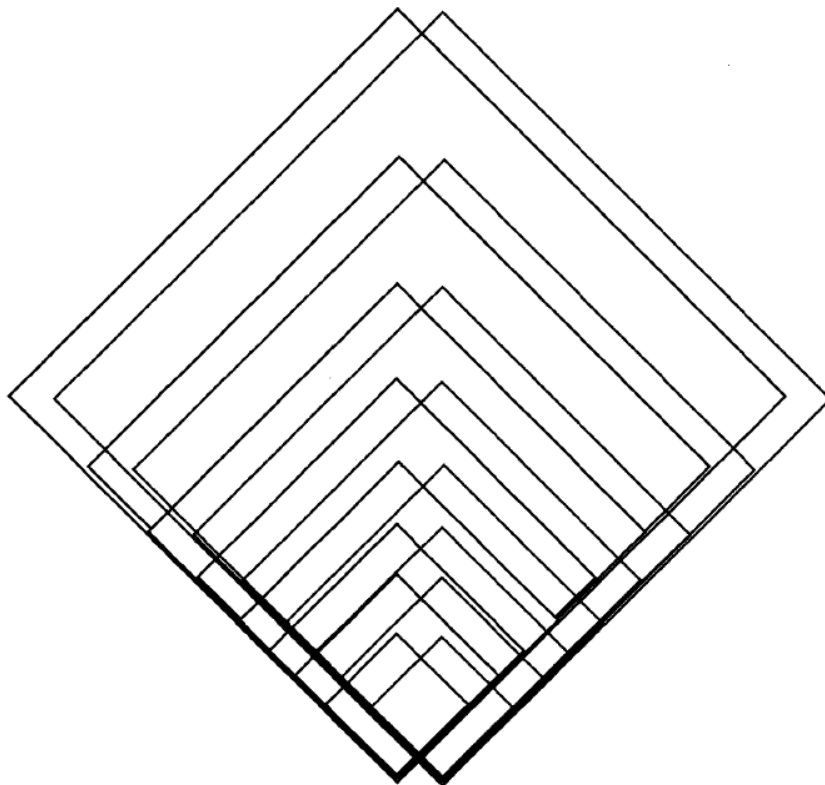
- So maybe all our smart friends had something right: Lemaitre and Gamow's Big Bang would work; Guth's Inflation would work, and James Jean's & Fred Hoyle's "continuous creation" still applies in the same framework- The Universe not being in "Steady State", but "Space" with corresponding "Energy" still created continuously after the Bang.



Evolutionary Theory:
Density of matter decreases over time



Steady State Theory:
Density of matter is constant over time



The expansion wave of the big bang defines spacetime, along light cones emanating from the starting singularity. The expanding space starts to define the Hilbert Space associations, creating nodes and defining discrete increments of “space” and “time”. The Metrics appear as semi-classical artifacts, and are emergent from this mesh. Cosmology is then a “process of relaxation of the vacuum towards the equilibrium state”, as the initially high density PL singularity expands and unwinds. It is an initial state with many degrees of freedom, where all the forces are united, but with no clear quantum-gravity solutions: gravity, and the other forces, are low-energy emergent features, a result of the coarse graining of the Universe as it expands and creates matter.

The initial singularity can be seen as an infinitely dense soup of “blackholes”, which start to diverge and dilute, possibly initiating multiple expansions from each of the “Black hole” constituents, resulting in multiple world, one of which is ours.

As Strominger points out, a Big Bang can be thought of as a point before which there are no degrees of Freedom. At the Bang, there are finally a few degrees of freedom. It is not a singularity “in” space & time (like a Black hole), but rather a singularity “of” space & time, marking their boundary. The actual singularity can be interpreted as “all space, no time”, a-la Hartle-Hawking no boundary proposal, since the PLs located at a single “point” cannot experience “time”. The Universe effectively “Tunnels in” from nothing, from the Netherworld. Before that, we have only the “Darkness of Reality, a void from which they were created and within which they operate” (Vedral).

In Penrose’s Conformal Cyclical Cosmology (CCC), he emphasizes that the conditions at the Big Bang and shortly thereafter, when temperatures exceed 10^{16} K, the classical picture of spacetime is not applicable, and a conformal geometry becomes more appropriate for the physical processes. This is because “rest mass” is irrelevant at these temperatures, and the energetic soup is primarily radiation, with the concept of mass still not relevant.

An interesting perspective: As we look out into the Universe from our vantage point, you would think the farther we see, the bigger the Universe would look, as our “Horizon” is enlarged by light reaching us from points farther out. But in fact, the farther we see, the “EARLIER” we see, and the earlier we see, the smaller the Universe we are seeing! The CMBR we see was created around

300K years from the big bang, when the universe became transparent to radiation, and the Universe was a lot smaller! If we find ways to look farther past that opaque boundary, by using neutrino-scopes or gravity waves, we could eventually see the point of the Singularity! As one wit put it, at greater distances, we are surrounded by a point!

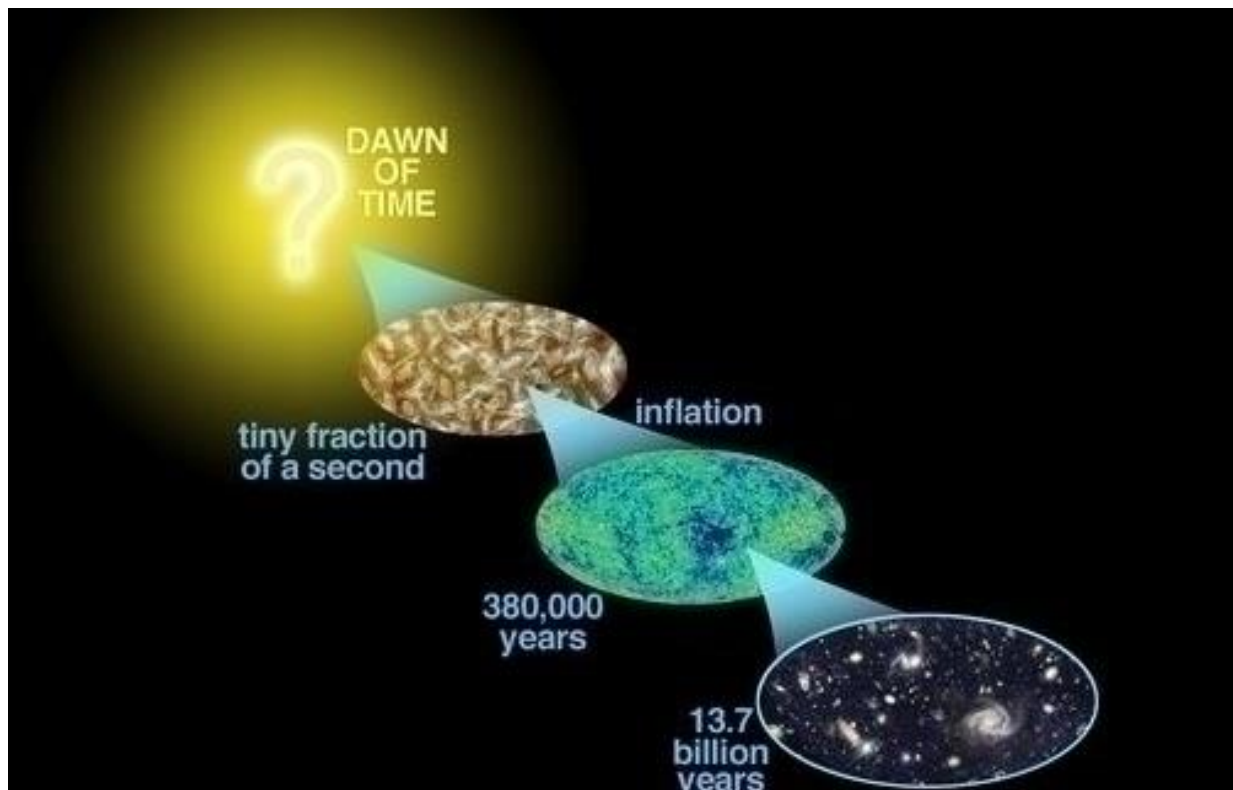
"The Tao begot one.

One begot two.

Two begot three.

And three begot the ten thousand things".

- Lao Tzu, Tao te Ching



"In the beginning, the world has nothing at all,

Heaven was not, nor earth, nor space.

Because it has not, it bethought itself:

I will be. It emitted Heat." – Ancient Egyptian Text

8.2 - EXPANSIVE UNIVERSE

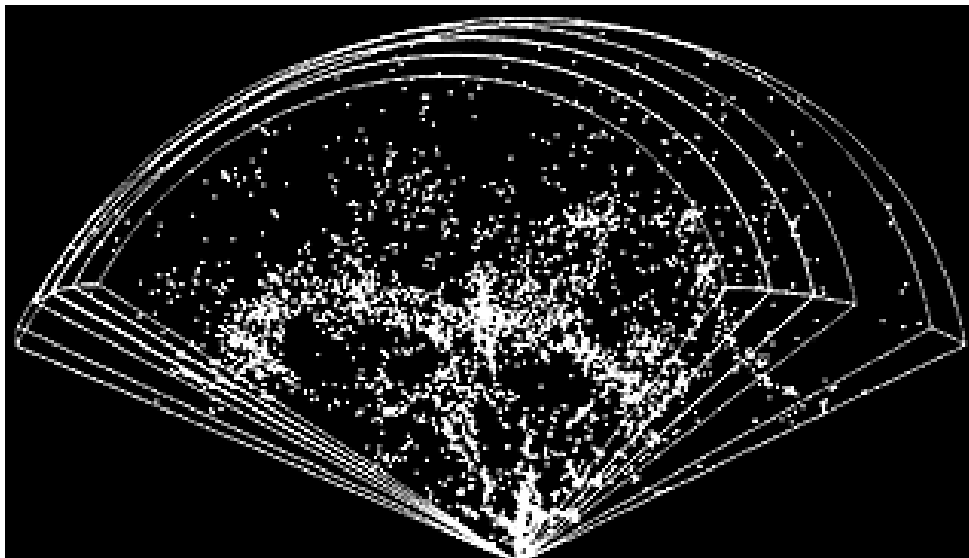
The current expansion of the Universe is driven by the constant generation of new nodes in the space fabric. This expansion is fed by:

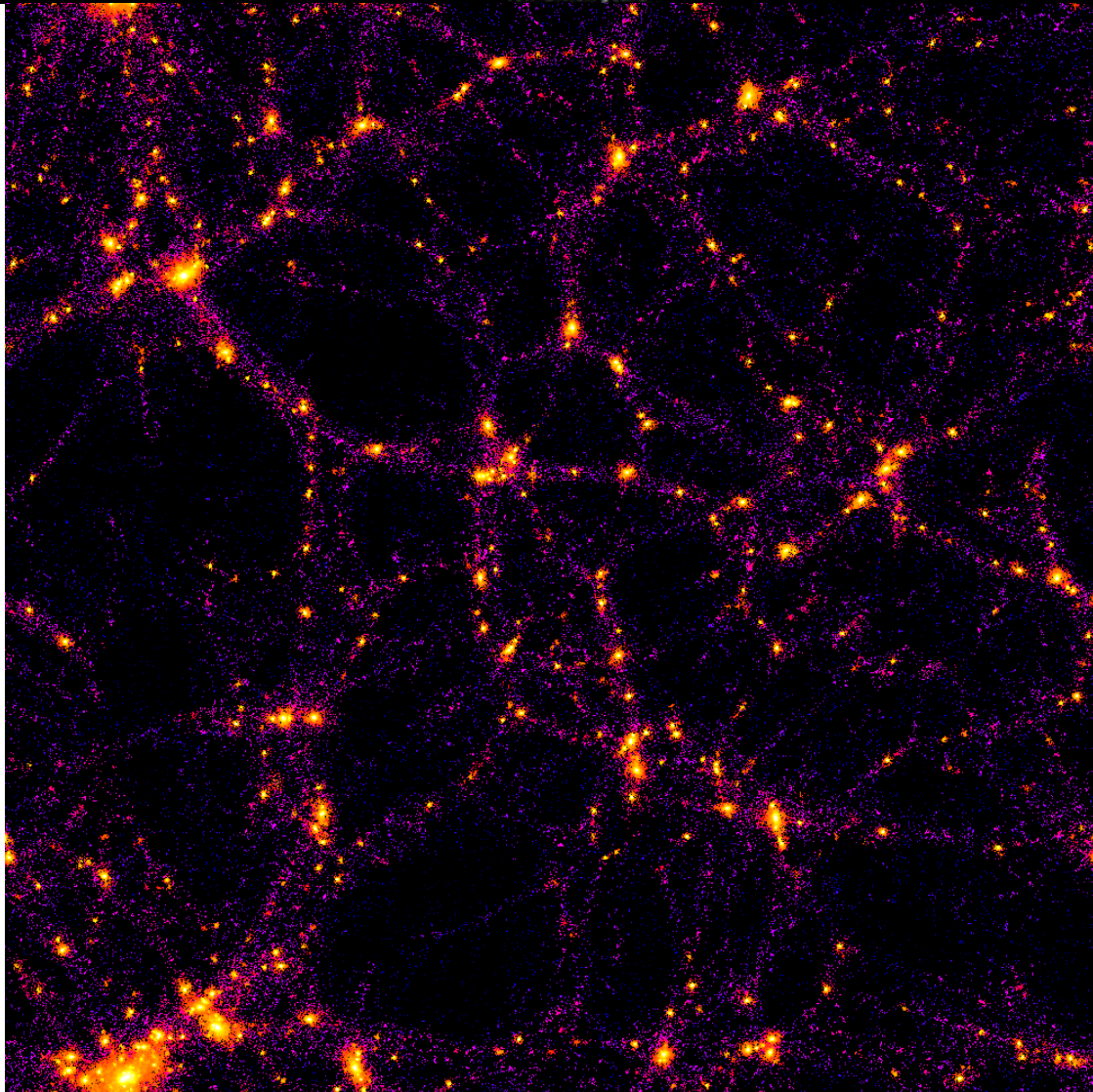
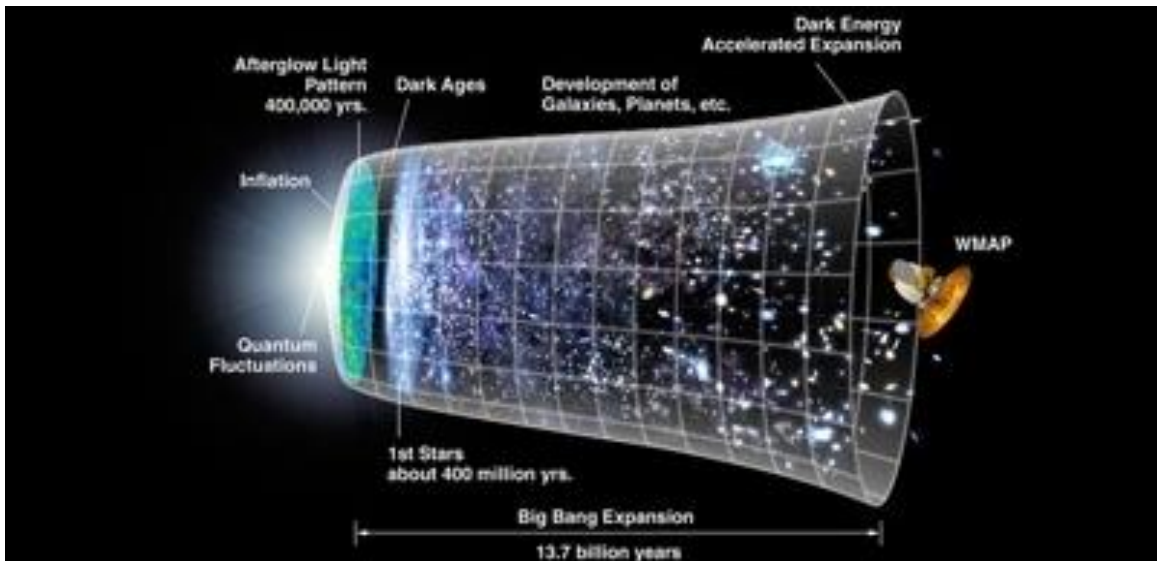
- The logic of existence, first cause of creation, with new nodes being generated spontaneously in the “vacuum”.
- “Resonant” excitation of the Nil-Source by matter and Energy concentrations (PLC clusters, remnants of the Big Bang), adding to the Dark Matter content, augmented by diffusion of PLs from matter (Pilot Waves) in synchrony with the Nil-source.

The first of these is the Dark Energy of the Universe, causing an exponential expansion, increasing proportionately to the current size of space, thereby increasing its share of the expansion rate as time goes by. The Vacuum density in Universal voids does not decrease, since the generation of space by PLs brings its energy along with it. This has the effect of increasing the volume such that dV/V is constant.

The second is the effect of matter, a relatively constant impact causing a linear expansion that had been dominant in the early life of the (smaller) Universe, but now losing ground to Dark Energy.

The measure of the Hubble constant must take into consideration these effects, as well as the Red Shift anomalies resulting from (possible) Pilot Wave diffusion and loss of Photon Energy. The universe may not be trying to “shun us like a plague” (Eddington), at least not yet.



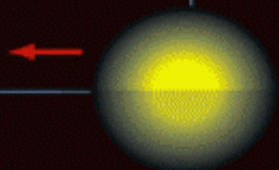

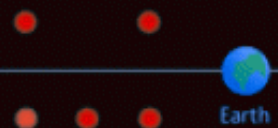
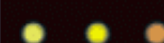
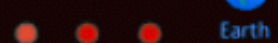


Galactic Clusters

8.3 - SEEING RED

The Red shift we see is a combined impact of the receding Stars and Galaxies due to expansion of space, as well as (possibly) the “Tired Light” of Photons who lose part of their energy (PLs) to the Pilot Waves they send out across space. This loss would not blur far away galaxies (as would “tired-light” hypothesis based on scattering light).

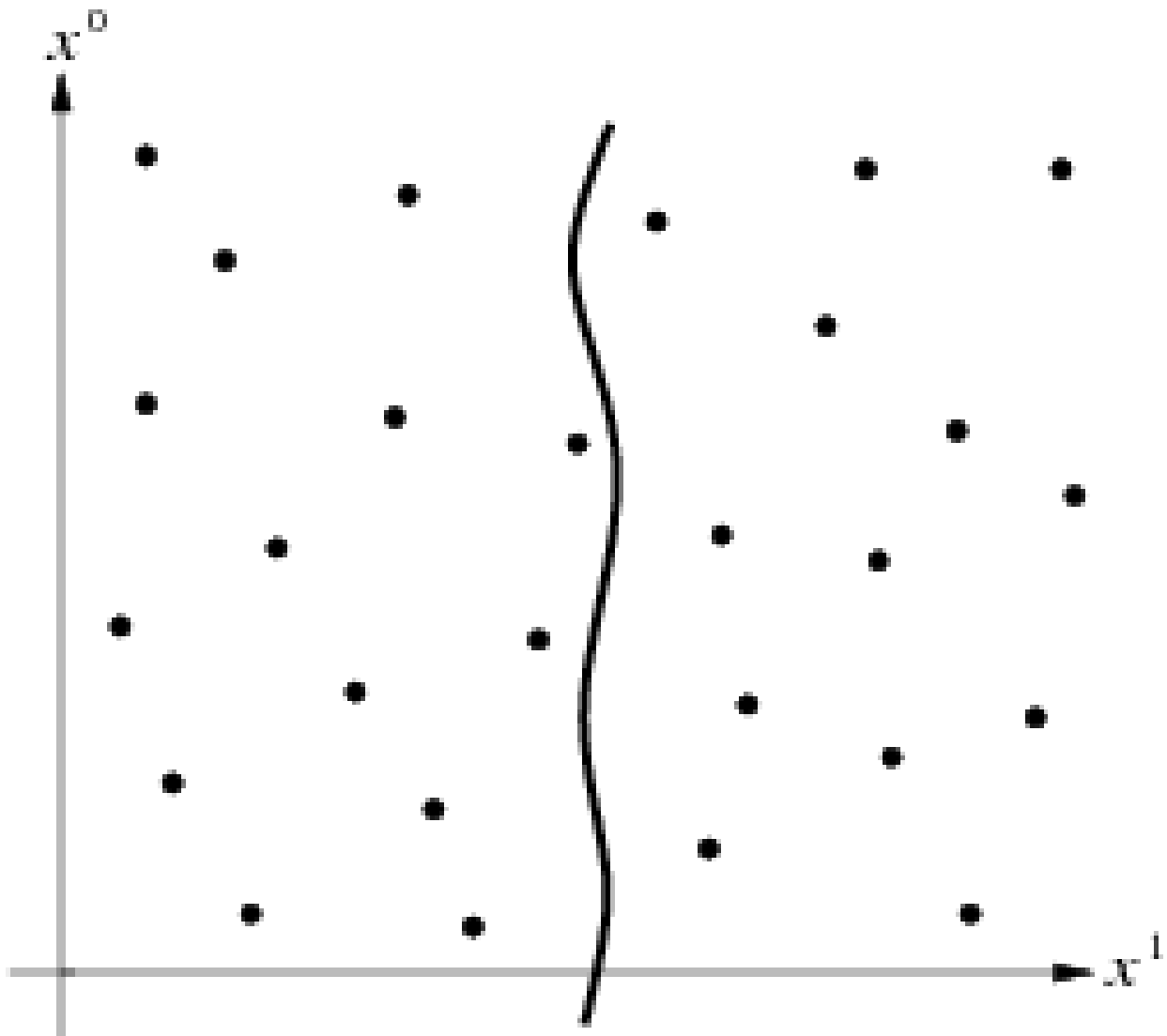
The impact of both needs to be considered when evaluating the actual Red shifts observed. Expansion of space is confirmed by the measured time dilation of Supernova light curves, and the standard “tired Light” explanations for all red-shifts have been discredited. But a small contribution of “tired light” due to Pilot Waves emanations could make the difference between reading accelerated expansion and a steady expansion. Recent data in 2003 also shows CMBR becoming hotter (more energetic photons) while passing through galaxies, a result attributed to Dark Energy effects on the galaxy’s potential well, making it shallower, which allows photons to exit with more energy than they had entered. The Jury is still out in my opinion on the accelerating Universe timeline, if not on its inevitability.

	Galaxies...	Young, distant galaxies are...	Galactic motion makes photons...	Redshift is due to...
Expanding Universe theory	move apart 	brighter	spread out 	galactic motion 
"Tired-Light" theory	stay put	no brighter	(no effect) 	unexplained energy loss 

Given the spurious nature of the Red Shift data so far used to predict an accelerating expansion, it may be premature to assert that acceleration as the Lambda-CDM model currently does. Astronomer Halton Arp has found many cases of galaxies and quasars in association, with different Red Shifts, enough to convince Sagan of underlying mysteries in those measurements. Geoffrey Burbidge confirmed many of Arp’s observations by studying ULXs (Ultra Luminous X-ray Sources). Many ideas also exist to explain the various

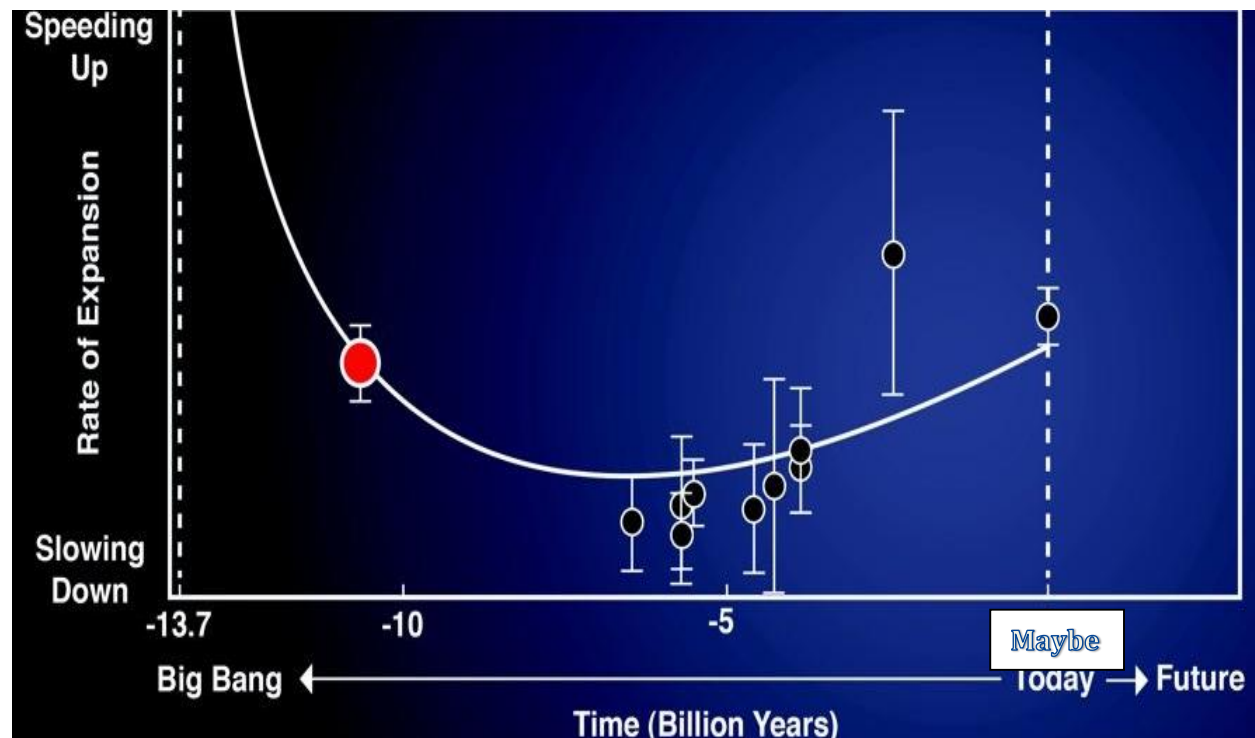
measurements (including variable light speed at high energies, etc.) for *certain* conclusions to be made.

While an accelerating Universe may be inevitable, it may lay still further in the future. Penrose's CCC sees even a "gradual decay" of particle masses in the infinite future, something that can also be seen as a reduction due to PL fields slowly attenuating particle contents, the same way we propose photon decay. The same dissipative effect of PL pilot losses would apply.



A key assumption we make in the PL model is that the PL creation rate (and hence space creation and expansion) is proportional to the existing space volume. This is based on post-diction from the shape of the expansion curves to date. It is not an unavoidable rule in the PL model, as one can imagine many

PL creations rates (e.g. constant rate) that lead to different expansion models. But the current model data seems to indicate an accelerating rate, which leads to an increasing PL creation prediction. It also makes heuristic sense that the PL creation in a Hilbert Space would correspond to the size of that Hilbert space, all else being equal.



The Good news (if you worry that far ahead) is that the constant creation of space and concomitant Vacuum Energy (with particle and photon creation due to fluctuations) means space will not be as empty as those who speak of the “Heat Death” or Big Freeze have feared. Maybe the Universe is “self-gauging”, as Arthur Eddington presumed. Perhaps the “Cosmic Rain” (Friedlander) may be just what we need.

"Commonsense-in-Science Manifesto"

**1. . . . A wave phenomenon requires a medium,
So: . . . a wave cannot propagate in vacuum.**

**2 EM waves (light) propagate in space,
So: . . . Space is not vacuum (say 'ether' medium).**

**3. . . . Perpetuum mobile (loss-free) processes do not exist,
So: . . . Wave propagation (light travel) is not lossless
And if linear loss: redshift proportional to distance travelled.**

**4. . . . Speed of wave propagation depends on medium density,
And: . . . Density varies with Gravity field around heavy body. [!]
So: . . . Interstellar space is filled with inhomogeneous medium,
So: . . . Lightspeed is not constant, and light bends around a star.**

**5. . . . With matter (electron) as closed wave (closed photon):
It makes sense that rotating matter (Earth) drags ether along.
So: . . . This adherence prevents ether-motion measured along Earth
surface.**

**(Michelson_Morley's null-result is no surprise, but their
'conclusion' (no ether) _is_ surprising, based on insufficient
grounds: neglecting the alternative of ether-adherence to Earth)**

**6. [!] . . . If ether density around heavy body decreases as $1/r$.
And: . . . Gravity is defined as its gradient,
Then: . . . Gravity decreases as $-1/(r^2)$ ---> Newton's gravity Law.**

**7. The constancy of lightspeed c holds for all frequencies with accuracy
 10^{-21} .**

**. . . This points to the existence of a medium that determines speed c ,
since photons**

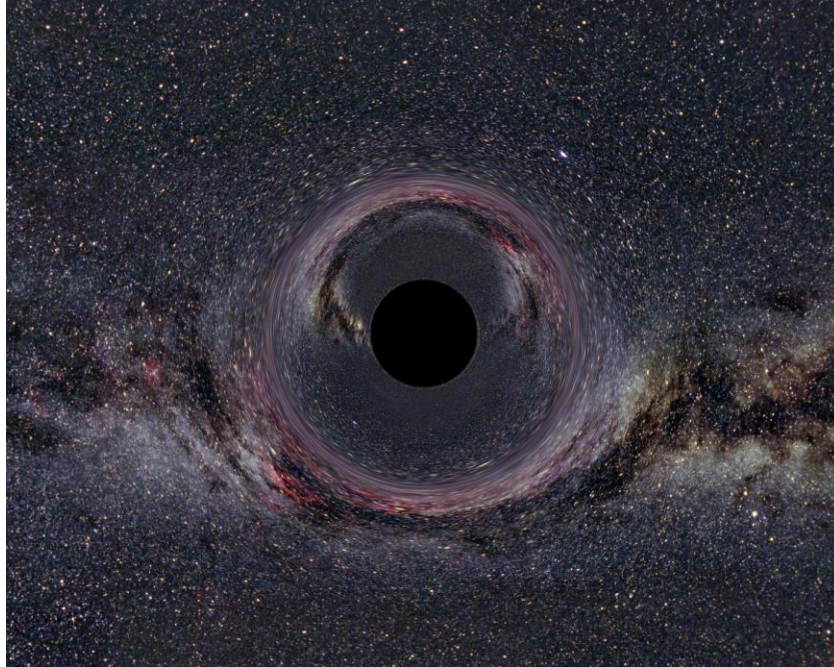
**. . . of widely different frequencies could in vacuum travel at various
speeds as**

**. . . determined at their generation, and maintain those various speeds
forever.**

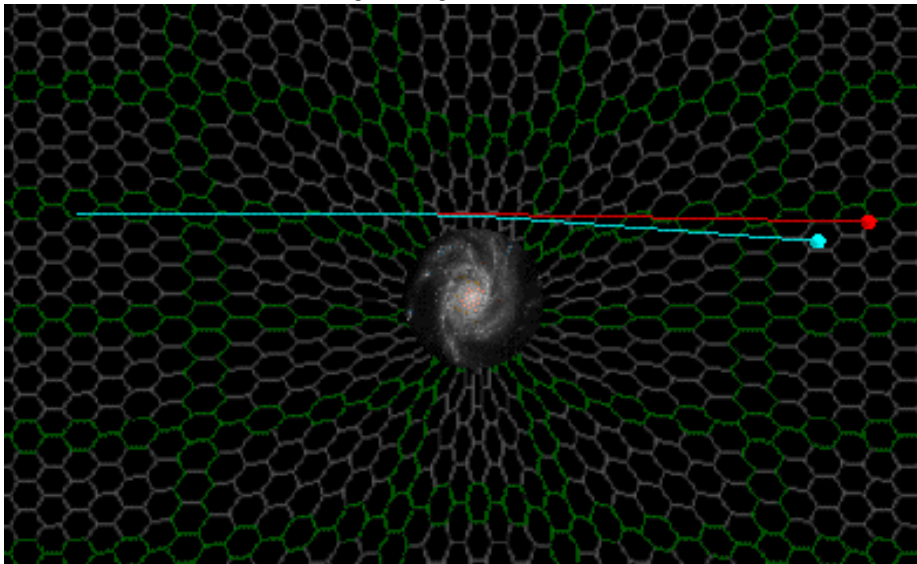
**So: Einstein's axiom of constant speed c induces the concept of a medium
for light propagation.**

"Big Bang, Black Holes, and Common Sense" by David Pratt

8.4 - BLACK HOLES



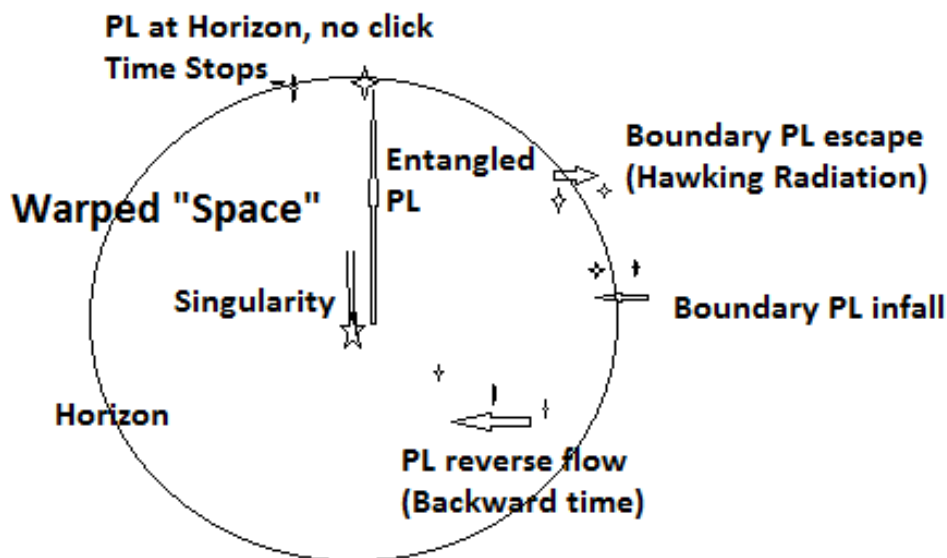
Milky Way Black-Hole



Black-Holes, those “Hadamard Disaster” space monsters that capture even light within their “Horizons”, are the ultimate in PLCs. As initial clusters bend the virtual space, more PLs move in, increasing the warp and accelerating the process.

A critical point is reached where the process is inexorable, and any PLs within a certain “distance” in the Hilbert space are drawn to that Vortex. Light, being a small PLC, trying to leave, gets drawn back in, its reverse motion being

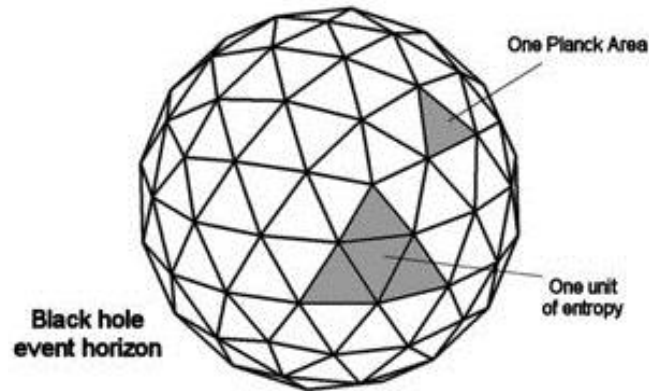
equivalent to a reverse flow of time (since its forward clicking normally measures time). At the Horizon, it is just balanced, not going this way or that, and hence time stops.



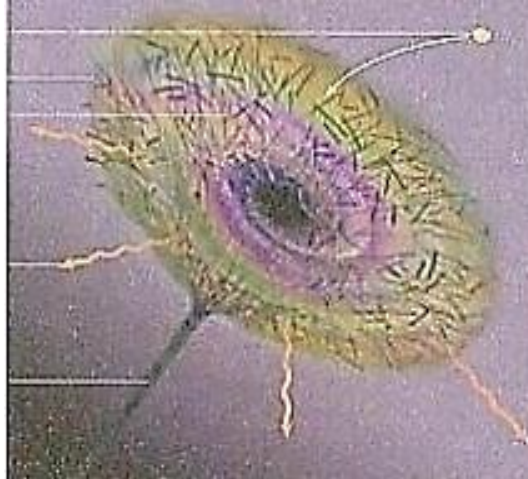
BLACK HOLE

- The eventual huge density at the center of the black hole would look like an infinity, a singularity, a reverse of the Big Bang scenario on a smaller scale, once the density of “energy” reaches planck scale at the planck length (one reason we cannot investigate that scale). In fact, however, as in the Big Bang Singularity, once the PLs reach the single point at the center, time stops and space disappears again. As mentioned earlier, this Singularity could “explode” into a Hilbert space of its own, since it cannot expand into ours due to warped space around it. It could spawn a new world. This is Lee Smolin’s idea in “Life of the Cosmos”, where he sees these “breeding” Black holes in a Darwinian struggle for supremacy in a multi-verse produced by them.
- T. Damour describes a cosmological singularity as a “de-emergence” of space, in the sense that the 11-dimensional description of M-Theory gets replaced (roughly when the curvature exceeds the 11-dimensional planck scale) by a 1-dimensional model (where the only remaining dimension is timelike). This is our “additive” PL singularity. Ashtekar proposed a model where “Quantum geometry in the planck regime serves as a bridge between two large classical universes”, resulting in a

“big Bounce” in the case of the Universe as a whole, or a new universe in the case of a blackhole. The “Quantum geometry correction naturally comes with a negative sign, making gravity repulsive in the Planck regime, giving rise to the bounce”.

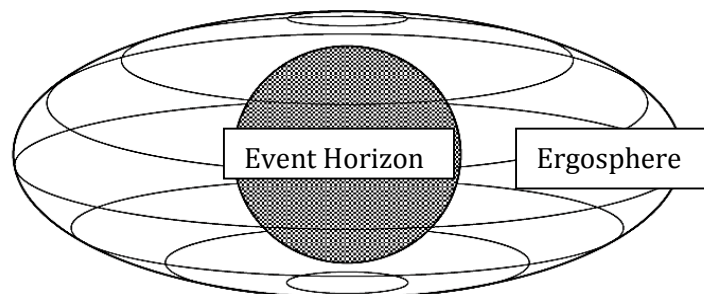


- At the Horizon, the PLCs (or virtual particle PLCs) at nodes that stride the warp limit could occasionally click, with those going outward exhibiting the “Hawking radiation” so hypothesized, giving the black hole an “effective temperature”. Since a higher concentration at the center would make the gradient steeper, such “escapes” would decrease with increased Hole mass, reducing the effective temperature as predicted. In a similar vein, the larger mass would create a larger Horizon, which means a wider PL node network, where “stray” “Pilot” PLs reside, entangled with the PLCs that fell in, retaining a measure of “information” about them – an Entropy that then becomes proportional to the Horizon area (corresponding to the number of nodes in the horizon sphere) as predicted. The link between those particles that fell in and the antiparticles that escaped provides a superluminal channel of entanglement where the information is retained, another indication of QM potentials providing a faster than light infrastructure. Hawking and Bekenstein’s work again points to a link between QM, the structure of Space-Time, and thermodynamics, as our PL proposals admit.
- String theory’s “Fuzzball” conception of blackholes (Samir Mathur) sees the horizon (and the black hole) as a fuzzy ball of strings, where information can be stored in the horizon strings and imprinted on outgoing Hawking radiation. Another scheme suggests information might leak out by means of quantum teleportation between the entangled pairs of virtual particles (the one that escaped and the one that fell into the hole). Those ideas parallel our PL view above.



Lemaitre had shown that this point is not necessarily a Singularity, and the infinities can be removed with a different set of coordinates. Einstein himself doubted their existence in reality, showing that some models prevent the aggregation of matter below the Schwarzschild radius, as that would cause their motion to exceed the speed of light. More recent models show ways this can be circumvented, but it is always wise to keep Einstein's opinions in mind ☺. For example, Kopczynski has recently suggested that intrinsic angular momentum may prevent the occurrence of singularities.

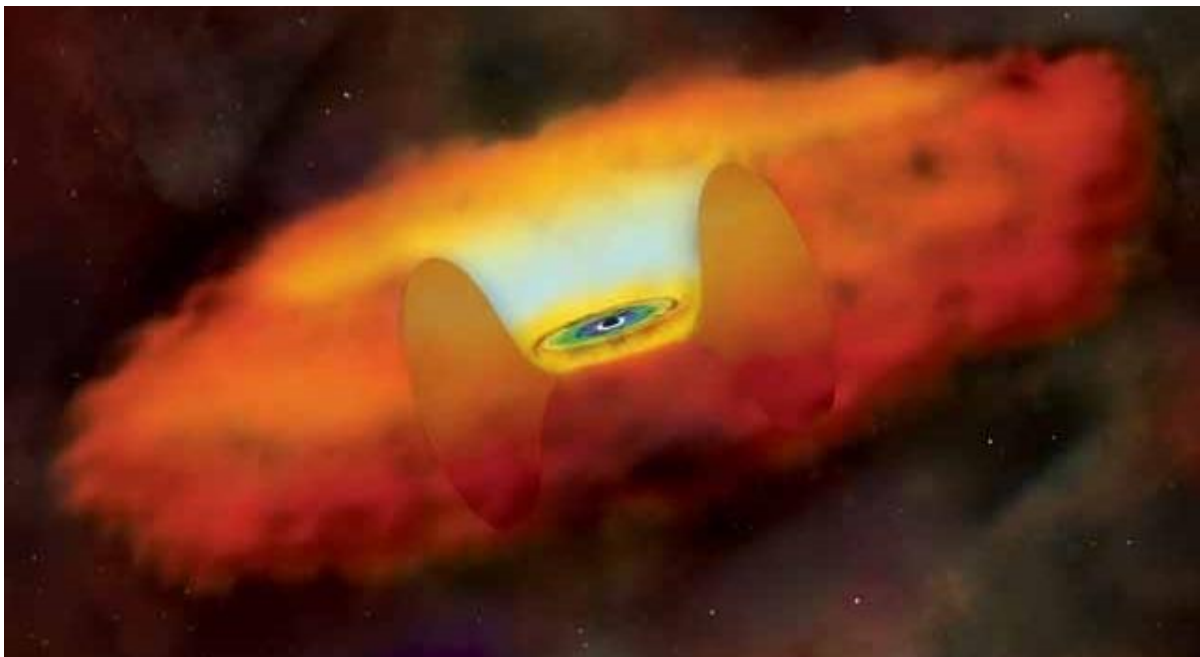
Much like Stockum's infinite rotating cylinder, these black holes also result in (Lense-Thirring) "frame dragging" when rotating, pulling with them the space-time mesh. This rotating 'ergosphere' is simply our PL mesh rotating around the massive PL Cluster vortex that is the blackhole, being correlated to it. It is Stokes' Ether Drag. Within this ergosphere the time metric acts like a spatial metric, and the particles must co-rotate with the inner mass to retain their time-like character.



As many physicists speculated over the years, a central "nugget" deep in the black hole stores all the information carried by matter that gets trapped within the hole's Horizon. That central nugget is the PL Netherworld, retaining

the information via the entanglement and wave function with the PLs stuck at the Horizon. Witten has shown that a black hole is the holographic projection of a bath of hot particles in a boundary theory, a-la-Maldacena. On the boundary of this hole, the information is embodied by quantum fields. “When you max out a region’s storage capacity, you’ll create a black hole” (Greene).

The Hawking radiation energy “negative energy” particle that falls into the Black hole looks to us, on the outside, like a positive energy particle, and hence avoids the doom awaiting all “virtual particles”. As it crosses into the inside of the Horizon, it enters a “reversed world”, a netherworld of inverted PLs. The Horizon is the border between our classical world and that negative world. The particle’s wave function extends from it, and, right at the Horizon, “flips”. The Horizon is the zero-wavefunction point, which is why it only occupies one planck area – each planck area representing the end tail of a wavefunction, and hence carrying the entropy of the blackhole with it. That is where the holography comes from. Matter, a heavy cluster of PLs, can warp the space which it forms; so much so, that it makes the PLs in it not only inaccessible to the outside world, but also makes it look like negative matter, the warp essentially flipping the PLs. In a blackhole, time and space interchange roles, and the negative energy particle looks like a positive energy particle traveling back in time, along the radial direction towards the singularity, which looks to it like the beginning of time, while looking like the end of time for real positive energy particles.

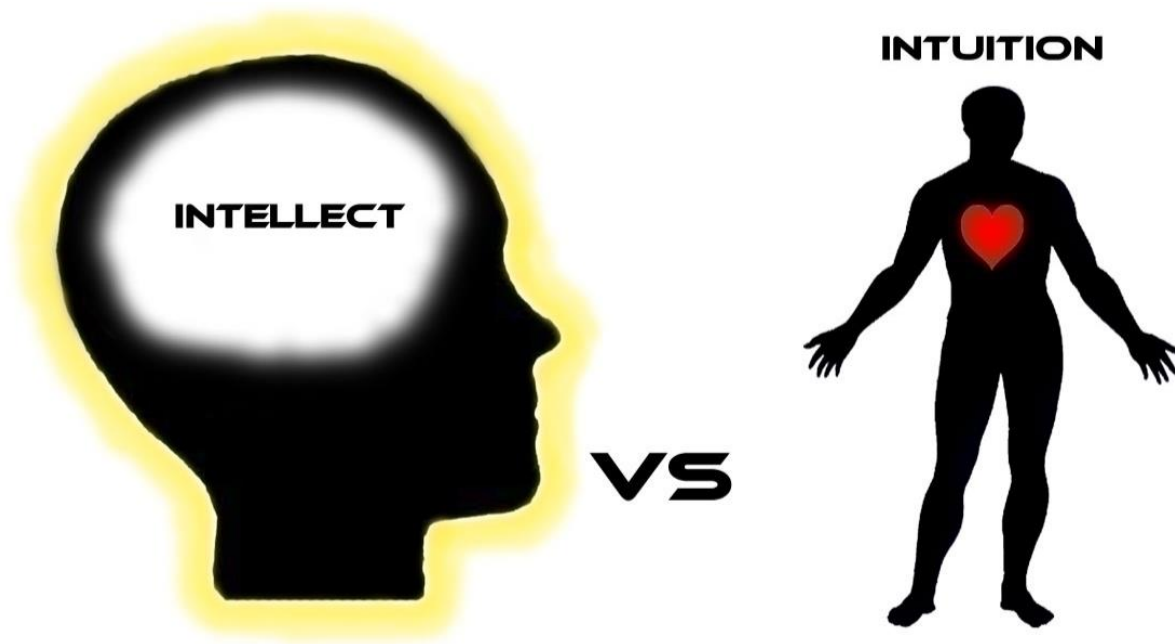


10 - A RESONANCE OF IDEAS

"If I have been able to see farther than others, it is because I stood on the shoulders of giants." - Sir Isaac Newton.

Many of the ideas discussed here have a reflection in ancient and modern science and Philosophy. The "Obvious" idea recurs in many themes.

As Jammer aptly said, "quotations are sometimes considered as crutches for the intellectually imbecile (sic)". But a recurring idea, over centuries of progress, in the minds of many who have thought hard about our state of existence, reveals an innate "feeling" in the soul of science. While many of those thoughts may not be stated in rigorous mathematical terms or with iron-clad proofs, they point to possibilities which later endeavors have consolidated and put on a firmer basis. Many an "intuition" has laid dormant, to be later turned into a revolution.



New concepts ride on ideas old. Many end up in blind alleys, and some circle the alleys lost for generations, until they see the light of day, a new thinker opening the right door.

"A Storm broke out in my mind" - Albert Einstein

"Because of the weakness of the human brain, we can't think of something really new, so we argue by analogy with what we know" - Feynman ☺

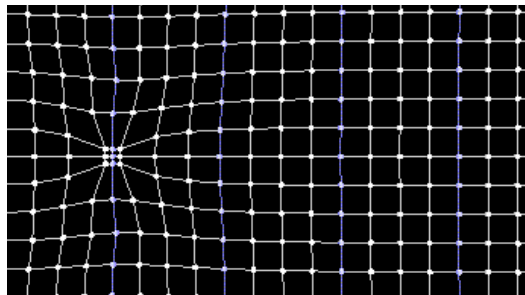
9.1 - SPACE-TIME

“In the beginning, was the great cosmic egg. Inside the egg was chaos, and floating in the chaos was P’an Ku, the Divine Embryo.” - P’an Ku Myth (China, 3rd century AD)

- The Concept of Light being the Parent of Space is an old one, at least Philosophically speaking. The Renaissance Philosopher Francesco Patrizi thought the first thing to fill Space is Light, the all-pervading, all preserving medium of three dimensions. “Let there Be Light” is the act of creation of both Light (Energy) AND Space, created before the stars and the Sun existed. Earlier still, Plotinus and the NeoPlatonists identified Space with Light – The means by which universal order is maintained.
- Theophrastus saw that space is not an entity, but only an ordering relation that holds between bodies and determines their relative positions. Leibnitz’s Monadology came closest: “Spatium est Ordo coexistendi”, the order of co-existing data, while the direction of the flow of time is determined by the causal inter-connection of phenomena.
- The Buddhist Ashvaghosha: “Be it clearly understood that space is nothing but a mode of particularization and that it has no real existence of its own ... Space exists only in relation to our particularizing consciousness”. D. T. Suzuki: “As a fact of pure experience, there is no space without time, no time without space; they are interpenetrating”.
- Sir William Hamilton espoused the “Relativity of Knowledge”, where “all human knowledge is of relations between objects rather than of objects themselves.”
- More recently, Ehlers, Pirani and Schild derived the metric structures of space-time from the phenomena of light propagation and free fall – space and time being derivative products, something Weyl had anticipated in 1921. Ehlers’s concepts look at relations between events, particles and light rays- space and time being sets of relations among things, not objects in themselves, agreeing with Leibniz’s foresight. Torretti, commenting on Einstein’s view of space in the absence of matter, says “space-time points are what they are only by virtue of their metric structure”, and “it is only by their mutual order and position that the parts of time and space are understood”. “They do not possess any principle of individuation apart from this order and these positions”.

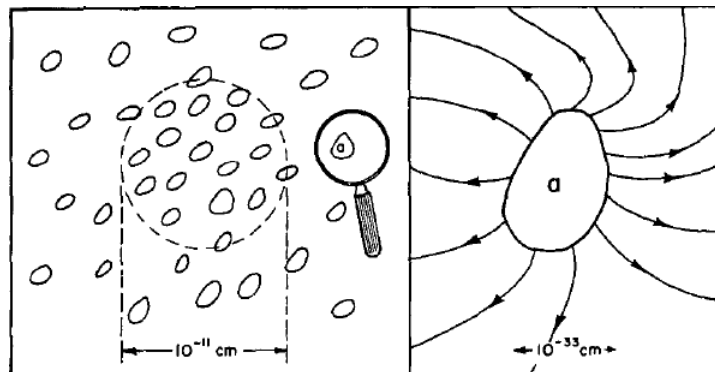
Swinburne says: “there is no space when there are no physical objects occupying it”.

- Others, like Teller, see space-time as a “substance” or “physical quantity” like mass or temperature, differing only in details of structure. Of course this invites the mirror view that mass and temperature (energy) are aspects of space and time.
- As Weizsacker Kurt Hubner said: “for Einstein, relations are defined by substances; for Bohr, substances are defined by relations”. From the above perspective, that is not a conflict, even though it generated a 90 year long discussion. An “Emergent” space-time view provides a navigable channel between Bohr’s Scylla and Einstein’s Charybdis.
- QED’s Renormalization techniques (Dirac’s “subtraction Physics” says Pauli ☺) finally made a breakthrough by assuming cutoffs above some extremely high energies, translating to very short wavelengths that do not exist, as on a lattice or discretized space structure.
- Clifford, in 1870, foresaw a fusion of Geometry with Physics, conceiving **matter and its motion as a manifestation of the varying curvature, seeing waves in the fabric causing ripples that may be interpreted phenomenally as motion of matter**. Einstein similarly saw matter as parts of the fabric of space-time- not lint on the fabric, but small knots in the fabric itself.

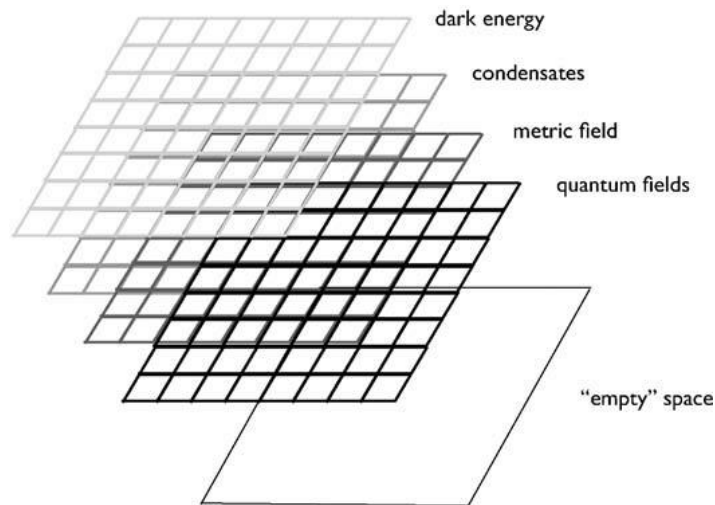


- Heisenberg suggested a “smallest length” to meet certain difficulties in Quantum Electrodynamics. This discretization of space Margenau quantified in “Hodons” (Greek Hodos, “path”), the “discrete manifold” of Riemann. March also advocated a “smallest length”, a possible candidate being the classical radius of the electron, or the range of the nuclear forces, in the range of 10⁻¹³cm.
- Callaway proposed a “Field” Theory where the field would constitute the ultimate, absolute datum of physical reality, an idea favored by Einstein in his later years: “There is no space without a field”.

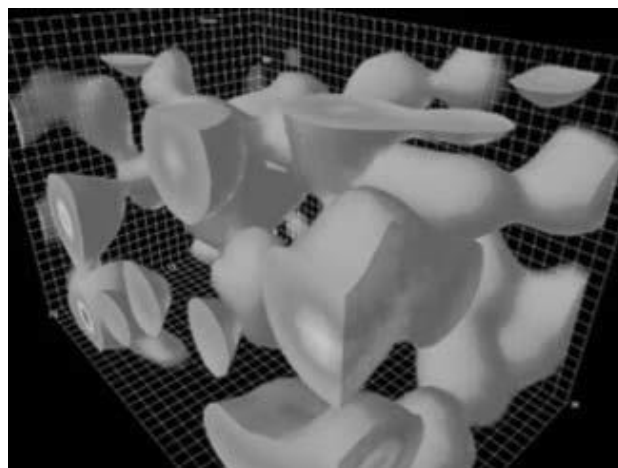
- Mehlberg, looking for a basic axiomatization of space-time, uses the primitive notion of “collision-connectibility of two events” - space and time being relative notions concerning interactions of the particles- our PLs. Salecker and Wigner saw our “measurements” as a macro effect of those correlations, with the concept becoming meaningless at the micro scale. Zimmerman suggested these concepts “arise from, but do not have analogs in, the properties of microscopic particles, in the same way that thermodynamic properties arise as a result of interactions among the many actually existing particles of the universe”. He agreed with Eddington, Wigner, Hoyle and van Danzig in the possibility of deriving the conventional notions of space and time from properties of macroscopic particles like spin, charge, mass, etc. Eddington thought this might explain the oddities of Quantum mechanics. Penrose took this logic in trying to relate the infinite-dimensional Hilbert space of Quantum Mechanics to our 4-dimensional Space-Time, using angular-momentum as a common denominator, to try to reconstruct space from spin networks- the “spin” axis providing a “direction” in space.



- Wheeler’s “Idea of an Idea” for pre-geometry based on logical calculus to derive the structure of space and time sounds very similar to the PL proposal.
- Putnam, Smart and others present gravitation, electromagnetism, charge and mass as properties of curved “empty” space-geometrodynamics being the basic driver of those properties.
- Wilczek sees a new ether he calls the “Grid”. He sees a matrix on which reality presents itself, in multiple facets – including Dark Energy, condensates, Gravity’s metric field, and the various quantum fields.

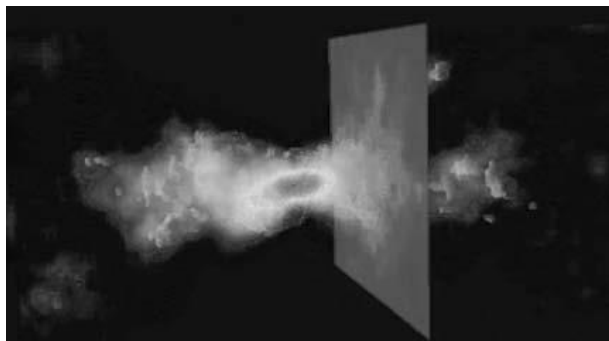


- Wilczek's Grid sees each fragment, each space-time element, with the same properties as every other element. He sees it alive with quantum activity, spontaneous and unpredictable, with real, enduring material components. A metric field gives it its "rigidity" and causes gravity. This primary ingredient of Reality has weight, and an average density. The Grid is the primary world "stuff". "Condensates" materialize out of this Ether, in a similar way to virtual particles, but often creating permanent particles, such as the quark-antiquarks produced by the chiral symmetry-breaking condensate, where Nothing produces a quark-antiquark pair, plus energy release. This "Condensate" field is sort of a solid mesh, whose vibrations produce observable π mesons, and whose leading candidate is the Higgs condensate, with its "God Particle", the Higgs Boson. The "Density" of this Grid is what we call the cosmological constant, or Dark Energy.



Quantum Grid

- This Grid would provide the negative pressure expanding the Universe – **$\rho = -p/c^2$** , providing the grid density, compensating for relativity effects, and filling the expanding space it creates. These fixed properties become the background of space, “Space” itself, on which the rest of the game (gravitational metric, quantum turbulence, etc) is played. Our PL proposal provides the same platform. Meanwhile, all current “condensate” options for providing this uniformly distributed Grid, carrying 70% of the mass of the Universe and affecting the curvature of “space”, calculate way off the actual measurement- by huge factors: Quark-antiquark condensate (factor of 10^{44}); Weak superconducting condensate (10^{56}); Unified Superconducting condensate (10^{112}); Quantum Fluctuations without Supersymmetry (infinity); Quantum Fluctuations with Supersymmetry (10^{60}).
- Wilczek’s Grid definitions sound very close to our PL concept:
 - The primary ingredient of physical reality, from which all else is formed, fills space and time.
 - Every fragment, each space-time element, has the same basic properties as every other fragment. (*Our PLs*)
 - The primary ingredient of reality is alive with quantum activity. Quantum activity has special characteristics. It is spontaneous and unpredictable. And to observe quantum activity, you must disturb it. (*Spontaneous emergence from the Netherworld; Reality definition*)
 - The primary ingredient of reality also contains enduring material components. These make the cosmos a multilayered, multicolored superconductor.
 - The primary ingredient of reality contains a metric field that gives space-time rigidity and causes gravity.
 - The primary ingredient of reality weighs, with a universal density.



- Contrary to popular opinion, Einstein did not disavow the Ether. His initial Special Relativity did not “require an “absolutely stationary space””, which people had been using the Ether for. On the other hand, his push for a “field” theory for everything meant he saw space filled with those fields, an Ether by another name, although he saw the energy of the particle concentrated in a singularity, with plane waves emanating from it, simulating Maxwell’s electromagnetic waves. He re-confirmed in 1920 that “More careful reflection teaches us, however, that the special theory of relativity does not compel us to deny ether.” While he did not say so explicitly, he may have regretted the overzealous abolition of the ether and the Minkowski space-time formulation developed by others in the thrall of his Special Relativity. His General Relativity was definitely Ethereal, an Ether supporting the Metric of gravitation- that Ether being the definition of “Space”. Completing his reversal, he declares: “According to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence of standards of space and time (measuring rods and clocks), nor therefore any space-time intervals in the physical sense.” For Einstein, Matter and energy are kinks and vibrations in space-time.
- Planck, after defining his famous constant, was thrilled with Willard Gibbs proposal which identified it with the elementary region in the two-dimensional phase space of the resonator. The linkages between discrete space, energy, and entropy became clear.
- Almost all the derivations of Planck’s radiation law start from the concept of phase space being divided into “cubes” of volume h^3 – Bose, Pauli, Sommerfeld, Einstein and many others used this starting point to derive the radiation law and the entropy, all fitting with the experimental data. The discreteness of phase space in turn implies a discreteness in 3-D space, and the digital nature of the world.
- As far back as antiquity, Philo would say: “Time began either simultaneously with the world or after it. For since time is a measured space determined by the world’s movement, and since movement could not be prior to the object moving, but must of necessity arise either after it or simultaneously with it, it follows of necessity that time also is either coeval with or later born than the world.” The idea of time as an emanent entity, derived from the motion in the world, is as old as time.

- St Augustine, in the “City of God”, believes: “Then assuredly the world was not made, not in time, but simultaneously with time. For that which is made in time is made both after and before some time- after that which is past, before that which is future. But none could then be past, for there was no creature, by whose movements its duration could be measured. But simultaneously with time the world was made.”
- The Arab philosophers had various views on time, but almost all associated it with motion. Averroes saw it tied to the motion of the heavens – the movement of the sky presenting a “reference frame” for time. While our awareness of time is essentially our awareness of ourselves as we undergo change, that is still tied to the celestial time. Time is defined as a measure of motion, with respect to priority and posteriority, and hence is causal and forward pointing. Averroes wondered whether, since time is associated with motion, that every motion had its own time (shades of modern Special relativity!), but concluded that the evidence is but for a single time- basically taking the “global time” provided by the heavens reference frame as the time for all. Avicenna also associated time with motion, but also with the “possibility” (imkan) of motion- so instead of time beginning at the creation of the universe (where first motion is realized), the “possibility” of motion before creation (by God’s omnipotence) meant that time also sort of existed before creation.
- The Arab philosophers tended to agree on the atomistic constitution of matter, and a chess board view of nature composed of these atoms. Many also agreed on the impossibility of a true void: Al-Kindi insisted where there is “place”, there is “something”. Al Farabi described experiments where he saw the vacuum as a “thinned out” material (example: Air expanding to larger volumes), but never empty. These views seem to parallel later views of an Ether to sustain the void.
- Al- Razi had a new perspective with absolute space and absolute time, while still maintaining that relative conception of both. He thus distinguishes between time (a relative temporal notion) and duration (an absolute temporal notion), as well as between space (a relative spatial notion) and void (an absolute spatial notion). Absolute “duration” and space are actual entities, and can exist if everything else disappeared. (I see shades of this in Thad Roberts’ superspatial and super time dimensions).

- Recent work by Gao, Shi & Adler looks at the motion of electrons and photons through a discretizing lens – using discontinuous motion ideas to describe motions in “blocks”, those “blocks” defining the particles, while still meeting QM rules and the wave-particle duality.
- Hilbert, that genius Mathematician who worked incessantly to establish the foundations of Mathematics and Physics on an axiomatic approach, and who **discovered the equations of general relativity independent of Einstein**, almost at the same time, said that theory: “teaches us that geometry and Physics are equal in rank, comprising one science resting upon a common foundation.” “Physics is a four-dimensional pseudo-geometry, whose metric is related to the electromagnetic qualities, that is matter, by the basic equations...”. In his analysis of Einstein’s General Relativity and Mie’s Electrodynamics, he concluded: “the electromagnetic tensor of Mie is nothing but the generally invariant tensor obtained by differentiating the invariant L with respect to the gravitational potentials....”. “the four equations (which describe the generalized Maxwell equations) can be regarded as a consequence of the equations of gravitation.....we can therefore immediately make the assertion that, in the sense indicated, ***the electromagnetic phenomena are the consequences of gravitation***. In recognition of this fact, I discern the simple and very surprising solution of the problem of Riemann, who was the first to investigate theoretically the connection between gravitation and light.”
- Hilbert’s axioms and work regarding the structure of space and time, and causality, in his “Foundations of Physics”, showed that by a transformation of the gravitation equations to a sum of squares, then three of them have a positive sign, and one the negative sign. In other words, space and time (a-la-Minkowski) emerge naturally from the gravitational equations. His equations of gravitation coincided with those of Einstein, and he had derived them (very quickly, much faster than Einstein had, being a superior Mathematician) from considerations of geometry and invariance. His Electromagnetic equations coincided with those of Mie. Furthermore, the fundamental equations of electrodynamics depended on those of gravitation. Here is the unification many have been seeking: Nature as geometry, “the enduring Kern (Core)” of Hilbert’s magic. “... in general it must be possible to achieve a reduction of all physical constants to mathematical

constants. Thus altogether the possibility comes closer that physics would become a science of the nature of geometry...”.

- So there is an Ether, it seems, and we are back to the beginning. Higgs may be its name, and the recent discovery of the Higgs particle has put new life in the idea. Einstein called it the “new Ether” for a while. Einstein first described his “new ether” in a 1916 letter to Lorentz:

“I agree with you that the general theory of relativity is closer to the ether hypothesis than the special theory. This new ether theory, however, would not violate the principle of relativity, because the state of this ... ether would not be that of a rigid body in an independent state of motion, but every state of motion would be a function of position determined by material processes.”

Einstein also wrote in a 1919 letter to Lorentz:

“It would have been more correct if I had limited myself, in my earlier publications, to emphasizing only the non-existence of an ether velocity, instead of arguing the total non-existence of the ether, for I can see that with the word ether we say nothing else than that space has to be viewed as a carrier of physical qualities.”

In 1920, Einstein became more emphatic regarding the ether, recognizing explicitly that the ether was a necessary medium by which acceleration and rotation may be judged, independently of any particular frame of reference:

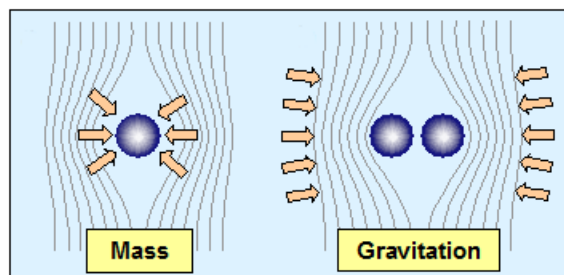
“To deny ether is ultimately to assume that empty space has no physical qualities whatever. The fundamental facts of mechanics do not harmonize with this view... Besides observable objects, another thing, which is not perceptible, must be looked upon as real, to enable acceleration or rotation to be looked upon as something real ... The conception of the ether has again acquired an intelligible content, although this content differs widely from that of the ether of the mechanical wave theory of light ... According to the general theory of relativity, space is endowed with physical qualities; in this sense, there exists an ether. Space without ether is unthinkable; for in such space there not only would be no propagation

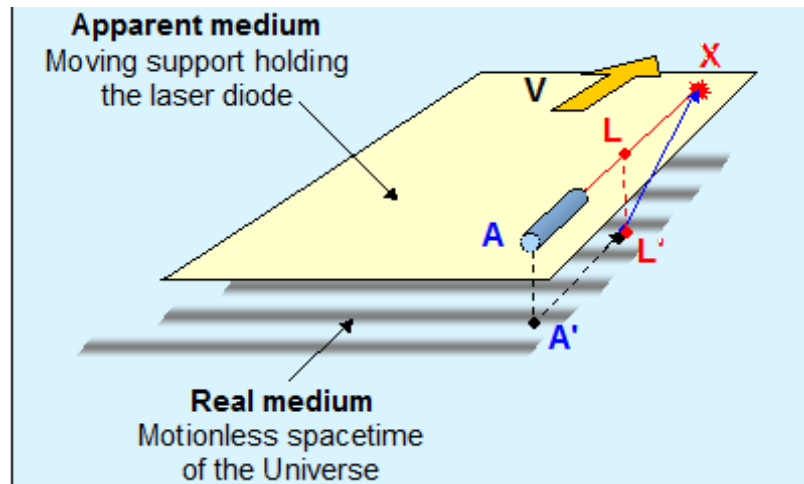
of light, but also no possibility of existence for standards of space and time (measuring- rods and clocks), nor therefore any spacetime intervals in the physical sense.”

- Krauss iterates: *“The brash notion predicts an invisible field (the Higgs field) that permeates all of space and suggests that the properties of matter, and the forces that govern our existence, derive from their interaction with what otherwise seems like empty space. Had the magnitude or nature of the Higgs field been different, the properties of the universe would have been different, and we wouldn’t be here to wonder why. Moreover, a Higgs field validates the notion that seemingly empty space may contain the seeds of our existence.”*
- As Sascha Voneghr says: *“The Higgs field possibly has the same uniform value v everywhere. Since it is a so called “scalar field”, it is also the same to every observer, regardless of how fast she moves relative to the average star background. Particles see the same Higgs field regardless of their motion.*

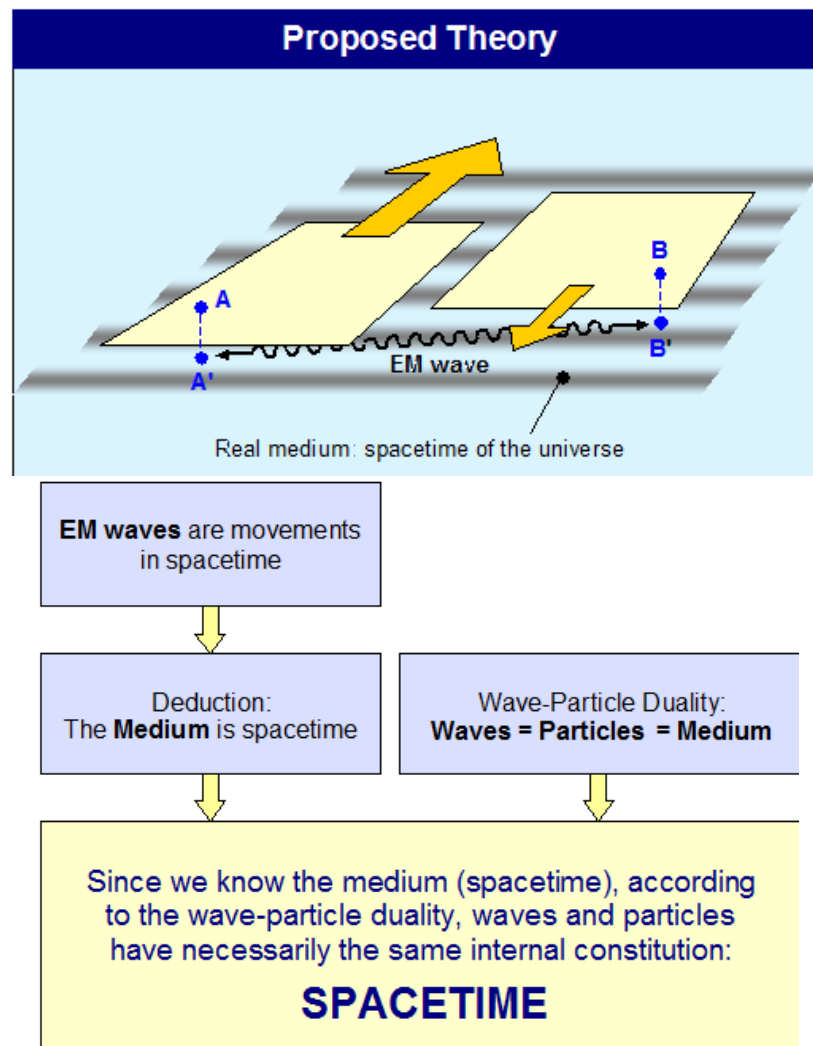
*The Higgs field breaks electroweak symmetry. If electroweak symmetry were exact and not broken, the electromagnetic and weak forces would have the same strength; photons, W- and Z-mesons would be indistinguishable, be the same things. The Higgs field permits the fundamental fermions (quarks and leptons like the electron) to have a mass. This rest mass depends on a coupling constant g that is different for each type of fermion. The rest mass increases with $g*v$ as if the Higgs field sticks to the particles like honey, making their acceleration difficult.*

All this sounds so much like ether that many people who favor a very geometric and “beautiful” description of nature have come to despise the Higgs mechanism. Well, physics is about experimental evidence.”

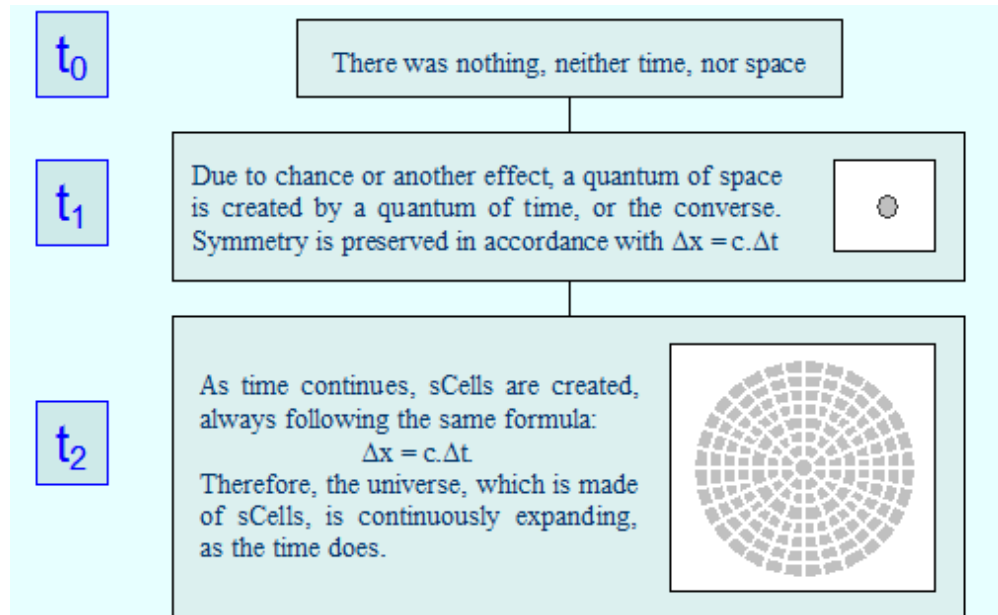




- Recent proposals for a theory of Space-time easily accommodate Special and General relativity with this new “Ether”, the spacetime-fabric.



That same model replaces our PLs with “space-cells” (s-Cells).



- As Don Lincoln says: *"Quantum fields are really a mind-bending way of thinking. Everything—and I mean everything—is just a consequence of many infinitely-large fields vibrating. The entire universe is made of fields playing a vast, subatomic symphony. Physicsts are trying to understand the melody."*
- James Jeans wrote: "When we pass to extremes in size in either direction – whether to the cosmos as a whole, or to the inner recesses of the atom- the mechanical interpretation of Nature fails. We come to entities and phenomena which are in no sense mechanical. To me they seem less suggestive of mechanical than of mental processes..."
- Theodore Jacobson emphasized: "The Unification of general relativity and quantum mechanics may lead us to abandon the idealization of continuous space and time and to discover the “atoms” of space-time." Clearly, as Gary Zukav notes, "Every phenomenon in quantum mechanics has a quantum aspect which makes it discontinuous."
- As far back as the eleventh Century, Avicenna noted that time is simply the collection of “accidents”, and that the “moment-accident” is what locates an atom. This relativist approach implied a quantized time.
- A thousand years later, Roger Penrose mused: "It may seem alarming that our very notion of physical space seems to be of something that

evaporates completely as one moment passes, and reappears as a completely different space as the next moment arrives!"

- The great Riemann predicted: "Now it seems that the empirical notions on which the metrical determinations of space are founded, the notion of a solid body and of a ray of light, cease to be valid for the infinitely small. We are therefore quite at liberty to suppose that the metric relations of space in the infinitely small do not confirm to the hypothesis of geometry; and we ought in fact suppose it, if we can thereby obtain a simpler explanation of phenomena. The question of the validity of the hypotheses of geometry in the infinitely small is bound up with the question of the ground of the metric relations of space. In this last question, which we may still regard as belonging to the doctrine of space, is found the application of the remark made above; that in a discrete manifoldness, the ground of its metric relations is given in the notion of it, while in a continuous manifoldness, this ground must come from outside. Either therefore the reality which underlies space must form a discrete manifoldness, or we must seek the ground of its metric relations outside it, in the binding forces which act upon it."
- More recently, P. Zizzi proposes a discrete space-time structure at the Planck scale, proposing a Quantum Computer View (QCV) where each pixel of the Planck area encodes a qubit, with the quantum space-time "processing" these qubits as in a network of logic gates (unitary operators), the processing essentially providing the dynamical evolution of the space-time matrix. Self-organizing models can explain the complexity and non-linearity, as well as the irreversibility at the macroscopic level. This is basically our PL model, with the PL Boolean logic replaced by a Quantum Qubit and Quantum Logic.
- Gerald Lebau's and Joel Morrison's "Sorce Theory" provides a view of a compressible sub-atomic superfluid as the medium for the wave-nature of matter and energy at all observable scales, in an infinite and eternal universe (with no creation). While the theory is philosophically overwrought (with its SpinBitZ spin) and many of the conclusions (especially on matter formation, with "new" names like Inx and Rinx) are outdated and ignore much of modern results, the basic ideas are worth reviewing. Unlike our PL picture, they see a "continuous" fluid, but still base the concept on wave-harmonics and fluid dynamics. The continuity, however, is only "apparent" and "effective", being part of an

infinite fractal regress of divisibility, tied to the SpinBitz approach, which denies the separability of existence. Reality is Physical, not mathematical. Yet it develops the idea that opposites are symbiogenetic, or “other engendering”, with neither substance nor its bundles being foundational, adopting the non-dual notion that form and “emptiness” (formlessness) are one.

Atoms are metastable vortices with harmonically quantized interior energy shells (initiated by rotation – spin generating bits), and multi-level “transitive” planes of “Holarchy” lead to similar behavior at the Cosmological (Star/Galaxy) level as in the Electric Universe and Plasma Cosmology models. Taking an occam-prone philosophical approach towards immanence, it hypothesizes an infinite regress of “Holons” (part-whole), but gives a tip to reality by accepting Spinoza’s “Simplest Bodies” as the starting Holons (e.g. atoms), to prevent an unending chain. Those “Simplest Bodies” enfold the complexity beneath them into a self-stabilizing, self harmonizing integrity, with properties (masses, etc) within narrow limits, so they can be used as “fundamental particles”, the basic building blocks of Nature for practical purposes. Motion is continuous, with “stasis” simply a self-stabilized relation and form of deeper matter in motion at the “aetheric” basement level (like our rotating Photons). Our PLC Clusters would fit that description.

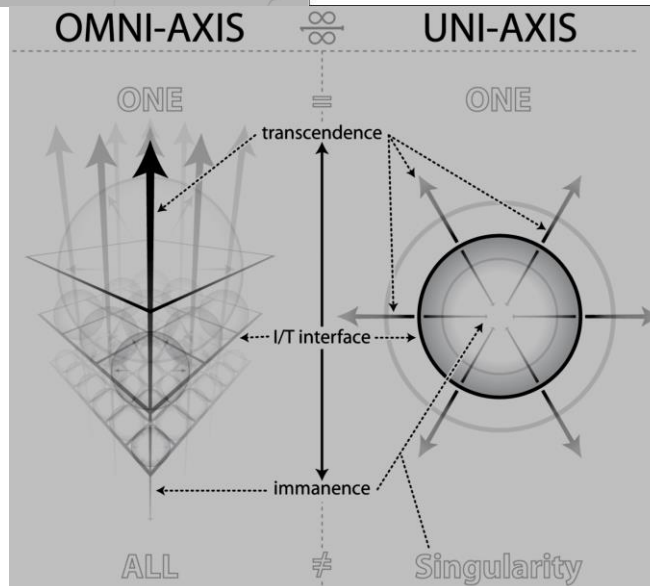
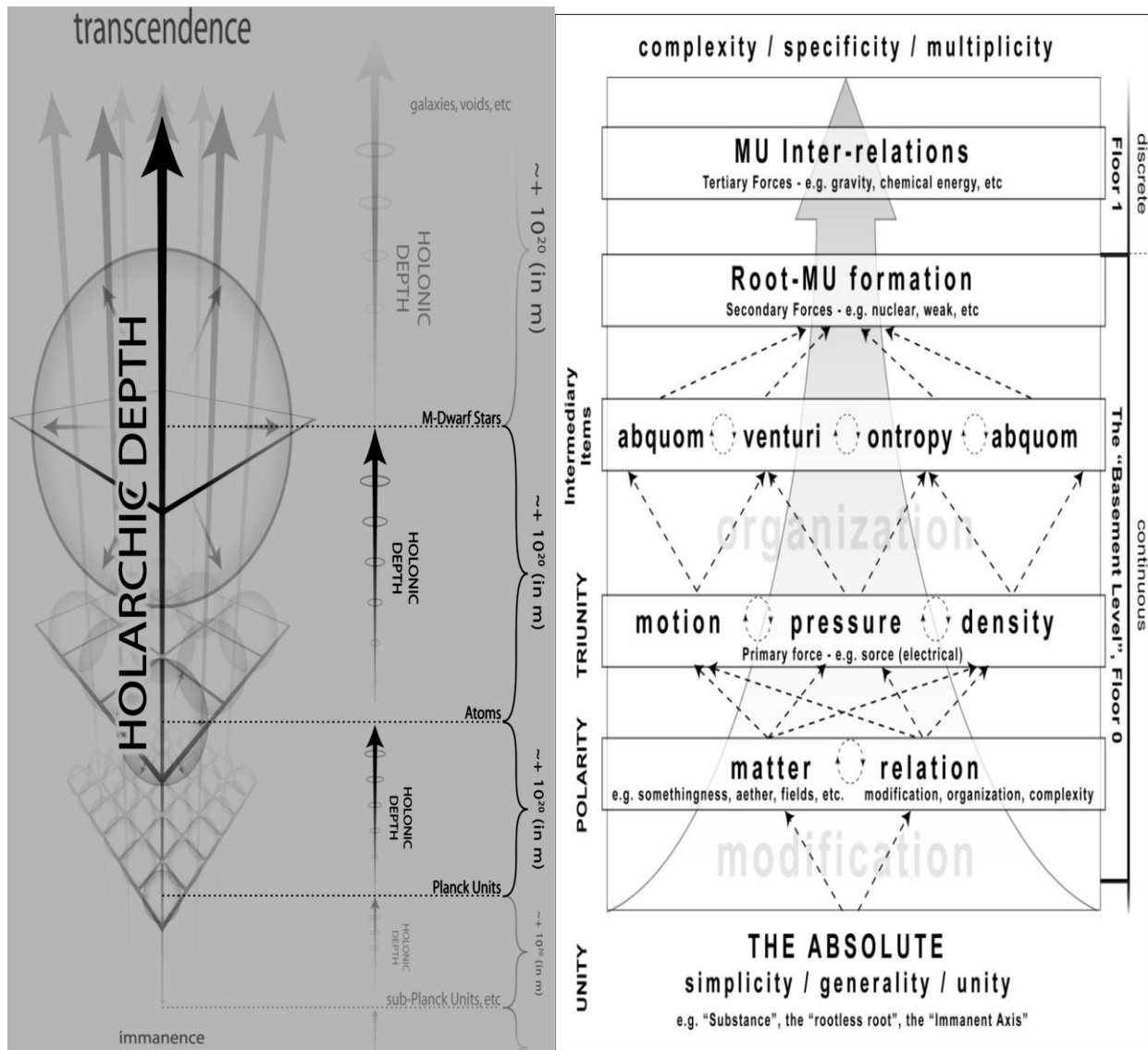


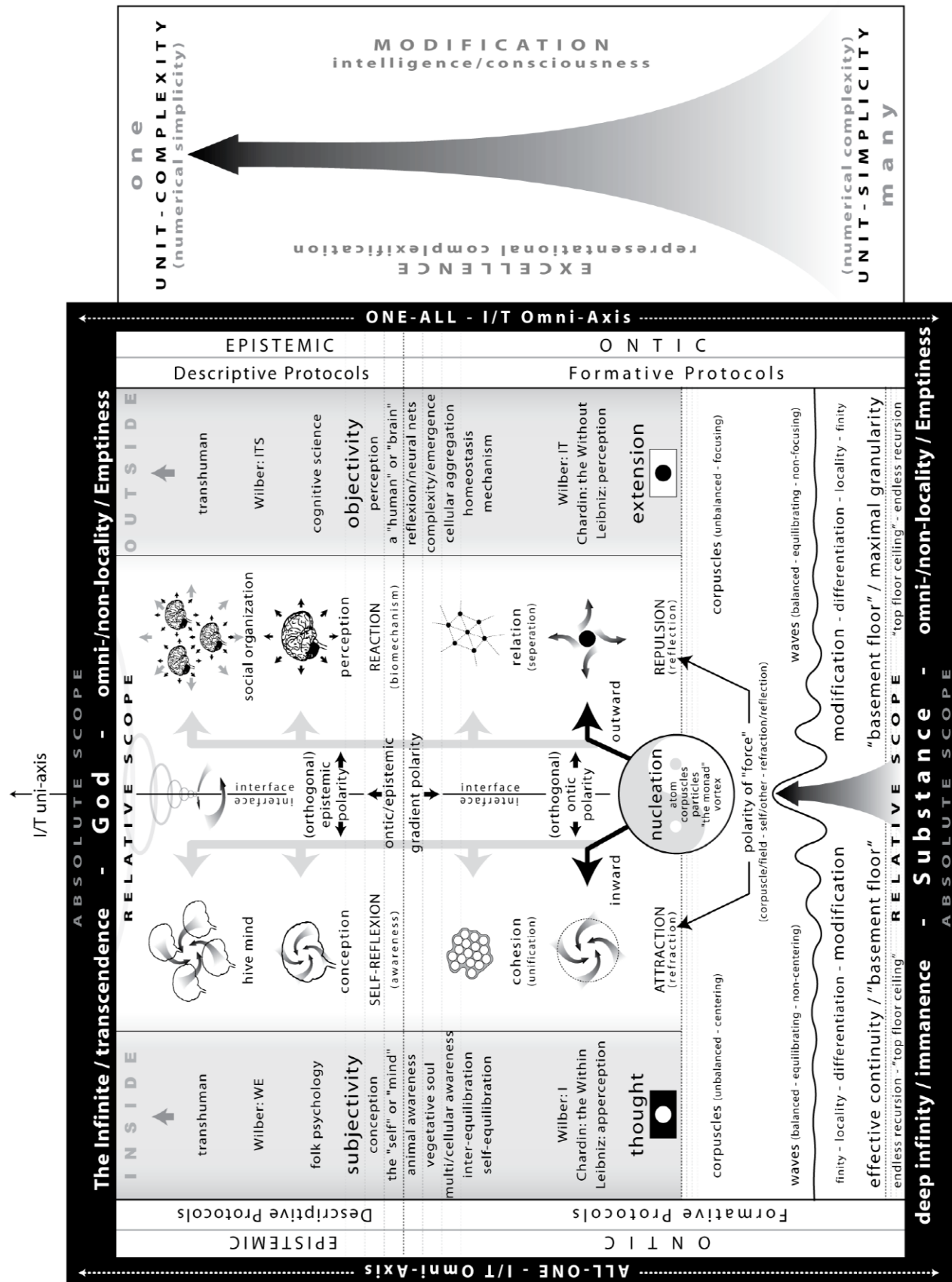
Sorce theory sees a second hierarchy, 10^{20} larger, at the Star level, which represents a second set of “simple bodies” but at a different level, and another one at the Planck level, where a sort of “reset” of Holonic complexity can be made. At our level, in between these “cosmic grooves” or levels of reality, things tend to be less stable and more changeable. We also see the lower level (Planck Scale) as “continuous”, due to the distance between our levels. The discrete nature of things is thereby masked by this “apparent” or “effective” continuity. The ideas echo Rob Oldershaw’s Self-Similar Cosmological Model, reminding us of the deep similarities of Nature at different levels, the Schroedinger atomic orbitals resembling Bode’s planetary laws, etc.

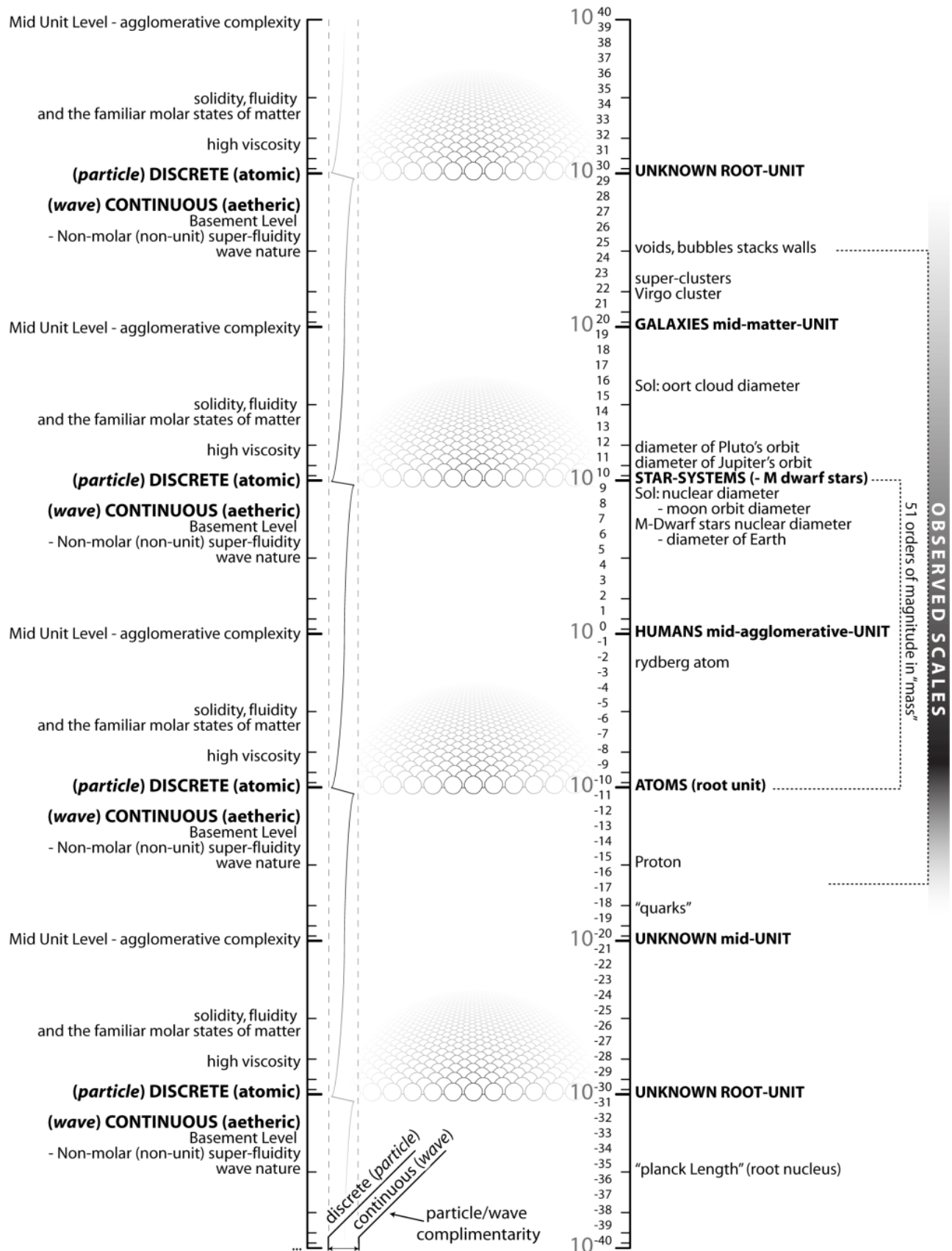
Pressure (aka Sorce) gradients in the planck-fluid drive all motion and forces, with a special role for “Venturi” effects. Quantization is vague, seen in the detector and not in the detected. Gravity is a refraction in the medium (Eddington’s old idea), and EM waves result from positive/negative pressure gradients, with magnetic effects vaguely forthcoming. The treatment is mostly qualitative and impromptu, but the concepts of fluid pressure and gradients in the “Aether” do reflect current views on field effects.

In a Mathematical world, those simplest bodies would be the unit-identity quanta, the first number one – similar to our PL. It is “the Unit-boundary, the chosen scale of measurement, allowing transitive operations of additions and subtraction (and in physical reality, agglomeration and evolution) to begin.” From immanence to Transcendence, it creates the various levels of “transitive planes” (defined to a specific scale), a nested set of holonic units, the holarchy of existence.

Sorce and Spinbitz views are interesting ways of viewing immanence, and the rise of complexity, as well as a geometric fluid picture of the world. A good shave from Occam would bring them back to modern developments and closer to reality.

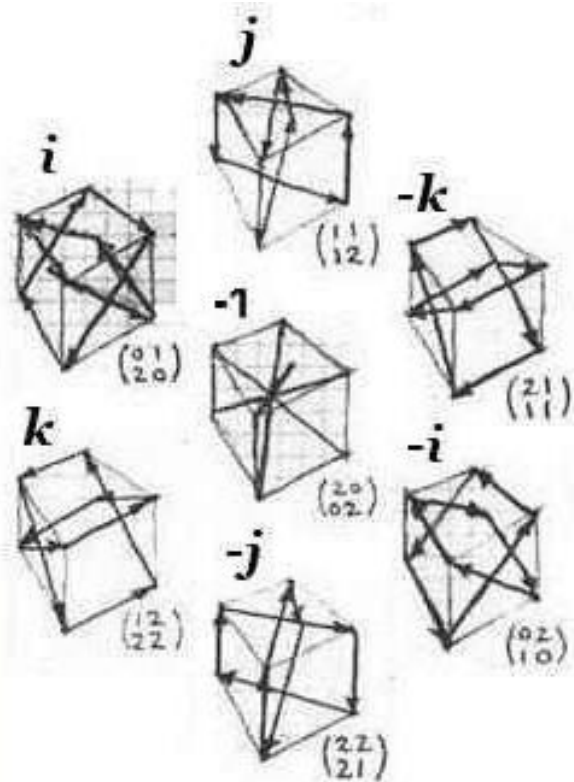




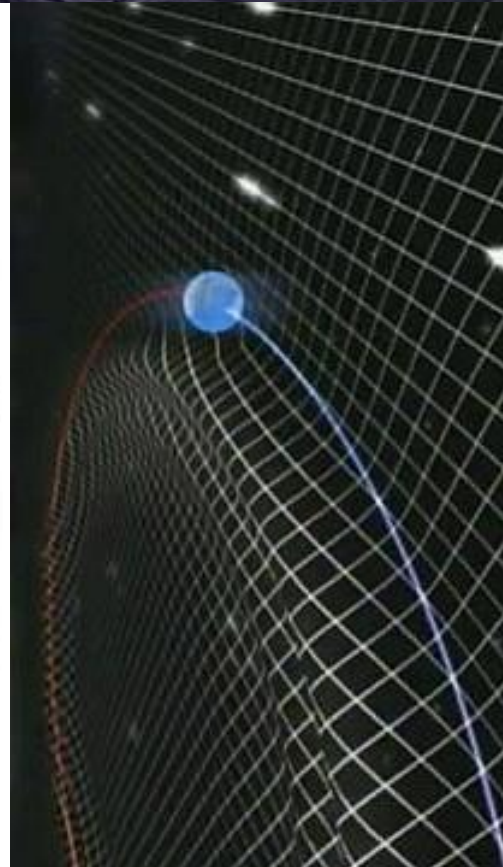


- Theodore Jacobson and Renaud Parentani have noticed that “the propagation of sound in an uneven fluid flow is closely analogous to the propagation of light in curved spacetime...”, suggesting that “spacetime may, like a material fluid, be granular and possess a preferred frame of reference that manifests itself on fine scales.” They went on to simulate an “acoustic black-hole” (a so called dumb hole ☺) through a Laval Nozzle, with a supersonic region simulating the inside of the black hole, and a boundary like the black hole horizon separating it from the subsonic exterior. Light speeds are compared to phonon speeds in the fluid.
- The early quantum pioneers, when faced with the infinities of QED (before the “renormalization” ‘Shell Game’ of Feynman & Co.), had advocated the quantization of space and time. Schroedinger suggested quantizing the Lorenz transformations, while Heisenberg thought that local quantum field theory is a provisional one, until we created a new theory that moved from a continuous structure to a quantized space and time.
- Back to Einstein: “If we imagine the gravitational field, i.e. the function g_{ik} , to be removed, there does not remain a space of the type (1) [flat], but absolutely nothing... A space of the type (1), judged from the standpoint of the general theory of relativity, is not a space without a field, but a special case of the g_{ik} field... There is no such thing as an empty space, i.e. a space without a field. Space-time does not claim existence on its own, but only as a structural quality of the field.” Physical entities are located with respect to one another only, and not with respect to the space-time manifold. As Carlo Rovelli puts it: “No more fields on spacetime: just fields on fields” – as they say, “the stage disappears and becomes one of the actors”.
- The statistical nature of reality, and the mind’s role in constructing its view of this reality, was emphasized by Eddington: “Mind filters out matter from the meaningless jumble of qualities... as the prism filters out the colours of the rainbow from the chaotic pulsations of the white light. Mind exalts the permanent and ignores the transitory... Is it too much to say that mind’s search for permanence has created the world of physics? So that the world we perceive around us could scarcely have been other than it is?”

All is spacetime



Quaternions on a Cube

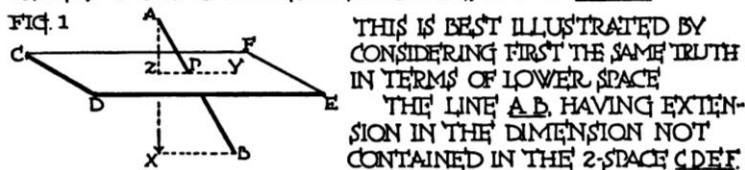


9.2 - DIMENSIONS

Claude Fayette Bragdon's "*A Primer of Higher Space*" at the turn of the twentieth century is worth a good look. With an artistic, true-believer, clarity, he has some astounding insights into the concept of Dimensionality. He perceives man as hampered by his inability to see past the 3 dimensions, which are only a "shadow" of a higher dimensional world, being only a "part of space *made perceptible*". He sees the 3-D construct a part of our evolutionary growth and consciousness, varying with the different levels of "conquests" life makes as it evolves. "Indeed there are indications that the butterfly is in possession of a space-sense which is still a mystery to us. Fabre himself cannot explain how the great peacock moth finds its mate in the dark and at a distance sometimes of miles".

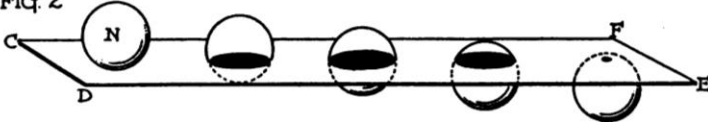
THE FOURTH DIMENSION MAY BE MANIFESTED TO US THROUGH CERTAIN MOTIONS IN OUR SPACE OF THREE DIMENSIONS BY TRANSLATING ITSELF FOR OUR EXPERIENCE, INTO TIME

FIG. 1



THIS IS BEST ILLUSTRATED BY CONSIDERING FIRST THE SAME TRUTH IN TERMS OF LOWER SPACE. THE LINE A.B. HAVING EXTENSION IN THE DIMENSION NOT CONTAINED IN THE 2-SPACE CDEF. MOVES IN THIS ADDITIONAL THIRD DIMENSION, DOWNWARD, TO WIT. THE POINT Z WHERE THE LINE PENETRATES THE PLANE. MOVES TO THE LEFT, FROM Y TO Z. AND THE TIME REQUIRED TO COMPLETE THIS MOTION FROM Y TO Z IN 2-SPACE MEASURES THE EXTENT PERPENDICULAR TO THE PLANE OF THE LINE A.B. IN THE UNCONTAINED DIMENSION. THAT IS, THE TIME MEASURES A.X.

FIG. 2



THE SPHERE N (FIG 2), IN TRANSIT ACROSS A 2-SPACE REPRESENTED BY THE PLANE CDEF, WOULD MANIFEST ITSELF IN THE PLANE AS A POINT, EXPANDING TO A CIRCLE WHICH WOULD ATTAIN A MAXIMUM DIAMETER EQUAL TO THAT OF THE SPHERE, AFTER WHICH IT WOULD SHRINK TO A POINT AND DISAPPEAR. FIG 3

SIMILARLY A HYPERSPHERE OR 4-DIMENSIONAL SPHERE OF RADIUS R, PASSING THROUGH OUR SPACE, WOULD APPEAR TO US AS A SPHERE WITH RADIUS GRADUALLY INCREASING FROM ZERO TO R AND THEN GRADUALLY DECREASING FROM R TO ZERO (FIG 3)

THE PHENOMENA OF LIFE-GROWTH ARE SIGNIFICANTLY SUGGESTIVE OF 4TH DIMENSIONAL ENTRANCES UPON 3-SPACE EXPERIENCE

Among his concepts, a "Filmar" universe would make "space" motions in a higher dimension (his Yamapura Fourth Dimension) look like "time" motions in ours.

"We may suppose that in some way unknown to us all the objects of our world have an infinitesimal "thickness" in the higher dimension."

"Our sense of time may be only an imperfect sense of space".

"Think of the fourth dimension, not as a new region of space - a direction, ... towards which we can never point - but as a principle of growth, of change, a measure of relations which cannot be expressed in terms of length, breadth and thickness."

"All higher dynamical reasonings use motion as a translator of time into space or space into time".

9.3 - HIDDEN REALMS

- The ancient “Kalam” Philosophy that dominated East and West in the Middle Ages, also came pretty close to this concept, concluding that space, matter, and time have an “atomistic” structure, and that this implied **physical motion as a dis-continuous process, a series of “leaps”** (clicks). They even expected that **all things move at the same speed/frequency** (light!), but that “slower” appearing bodies just “rest” more at the nodes! Our “rotating” PLC bundles, seen as matter, could be considering as “resting” or “loitering” in place. They saw **matter and space as being a transient existence of extremely short duration and range** (our PLs), **requiring “divine” intervention** (our Nil-Source logic of existence) **for maintaining its coherence and continuity**. Space being the “relationship” between those ephemereal entities.
- Al-Nazzam’s **notion of “Leap” as an explanation of motion**, is not far from Bohr’s “jumps”, and of our PL transitions. Abul-Hudayl, his uncle, postulated **“hidden states”** (our Netherworld?) **as intermediates in all this leaping and jumping**.

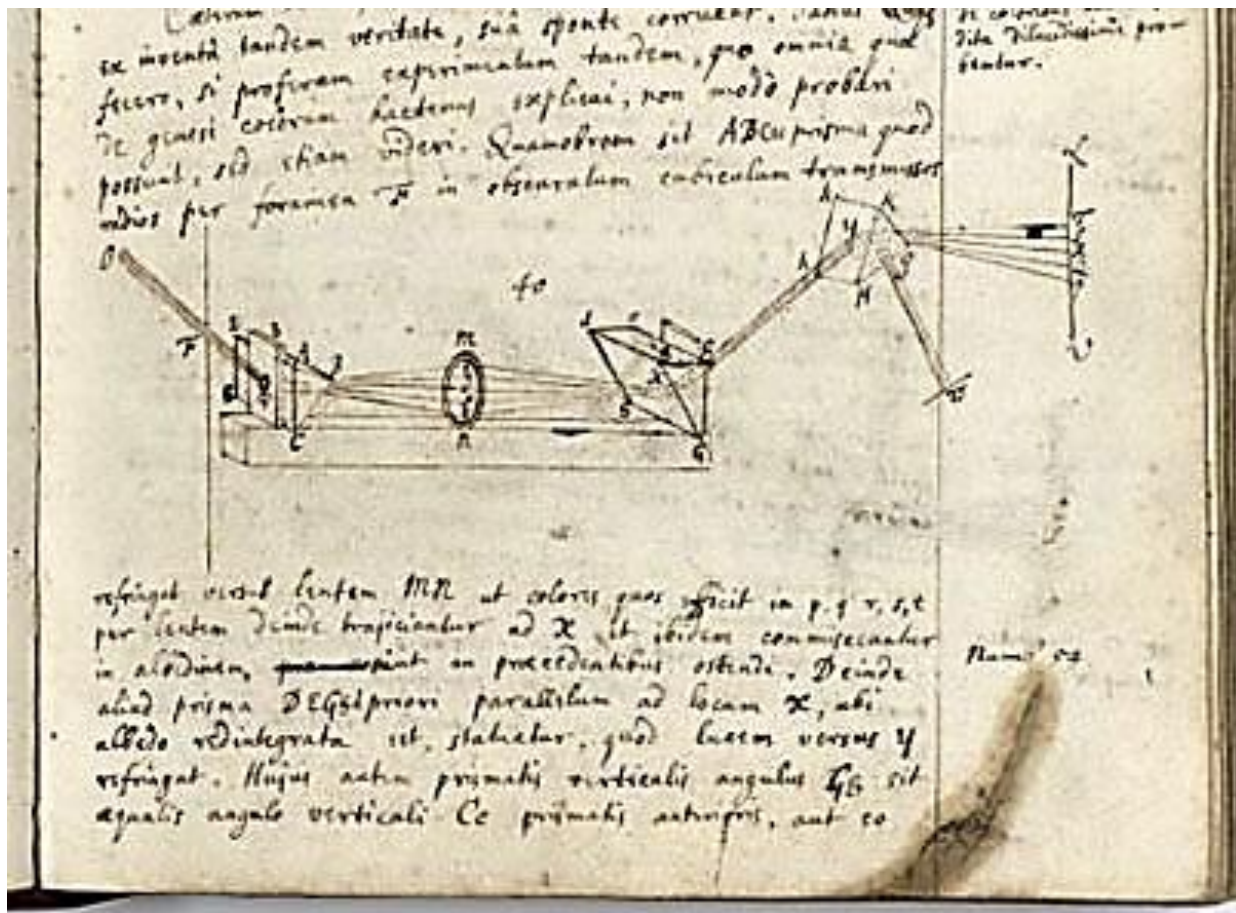


- Medieval Islamic theology had posited that God creates bodies all at once and at each moment, recreating the world at each moment.
- **Hertz suggested “hidden coordinates”, “hidden masses”, and “hidden motions” to explain the interaction of “apparently” remote objects.**
- Hans-Peter Durr, in proposing a “more radical” QM view, imagines an “ad hoc introduced space time continuum on which the octonic spinor stars are spread out..... The Octonic spinor star consists of four annihilation beams entering from the backward light cone, and four creation beams emerging into the forward light cone, with both 4-beams not quite touching at the origin because of the regularization of the self action”, basically a PL-like particle diving in and out of existence. “It is tempting to connect the evolution of the cosmos with a steady increase in the dilation parameter n_0 , starting at minus infinity at the origin and sweeping step by step over the whole future cone, enlarging the number of spinor stars along the 3-space hyperbola, which will look more and more like our familiar infinite spacetime continuum. The Planck length ... may perhaps be connected with the ‘minimum time’ of the creation and annihilation processes inherent in the basic step operators...”. “In a way, the cosmos would resemble a huge, continuously growing, parallel closely-linked computer system with software based on the 8-fold general linear transformations in a 2-dimensional complex space $GL(2,C)$ instead of the (0,1)-bit of our present computers. However, because of the basically creative elements and the infinitely open logic, the quantum cosmos, in stark contrast to our fully determined computer, would be essentially open to the future, and hence would correspond more closely to what in our limited meso-world we experience as being ‘fully alive’.”
- Bohm, in his later work, conceived of the “Implicate” order, a layer beneath our external “Explicate order”. “The whole Universe is in some way enfolded in everything and each thing is enfolded in the whole. This implies that in some way, and to some degree, everything enfolds or “implicates” everything. However, this takes place in such a manner that under typical conditions of ordinary experience, there is a great deal of relative independence of things.” The Explicate order is the “unfolded” version of the “enfolded” Implicate mode. The Implicate represents potentiality, while the Explicate provides actuality.

- Bohm provides again a holographic image as an example, and suggests that “all things found in the unfolded, explicate order emerge from the “Holomovement” in which they are enfolded as potentialities, and ultimately they fall back to it. They endure only for some time, and while they last, their existence is sustained in a constant process of unfoldment and re-enfoldment, which gives rise to their relatively stable and independent forms in the explicate order.” The essential qualities of the fields exist only in their movement. It is not that there is a field with some essential qualities, which then may or may not move. Rather, it is movement that is more fundamental, and the essential qualities (whether those of fields or particles) are derivative. It is the “movement” that provides the “causal” architecture of the entire structure.
- Bohm’s Hologram analogy draws our attention to undivided Wholeness, where the whole is in some sense contained in each part and each part is enfolded throughout the whole. Each part of a hologram contains information about the whole object in such a way that there is no point-to-point correspondence of object and recorded image (unlike a lens). The hologram records interference patterns of light waves that come off an object. Form and structure of the entire object can thus be said to be enfolded within each region of the photographic record. When you shine light on any region, this form and structure are then unfolded, to give a recognizable image of the whole object again. If a hologram is torn in half and light passed through the new halves then we can still see the whole object albeit with some loss of overall definition.
- For Bohm, the entire scheme is an algebraic process, with the implicate order being a structure of relationships partly based on non-commutative algebra, with measurement bringing out certain aspects of that non-commutativity (like the complementarity principle, and uncertainty), an event being “actual only at the moment at which it is unfolded. Nevertheless it is always present whether unfolded or not”. Our PL picture is an ideal mapping of these concepts, with its Netherworld and “Mathematical” (algebraic) structures building the quantum logic. Bohm’s view of particles whose “basic ‘elements’ are constantly forming and dissolving in succession” is similar to our PL dive into the Netherworld, although he sees it as a wave process of a given duration, “included within the implicate order as a particular form in Hilbert space”. That implicate order is substantiated by the “real”

wavefunction and the active information represented by the quantum potential. "... the particle movement is not understood fully as self-determined in the explicate order in which it is described. Rather, this explicate order reveals the deeper implicate order underlying its behaviour".

- Newton, in his study of Optiks, speculated that some kind of invisible transverse guide wave accompanied light corpuscles and controlled phenomena like diffraction and other wave-like properties of light. "Hidden Variables" determined which path it would follow.



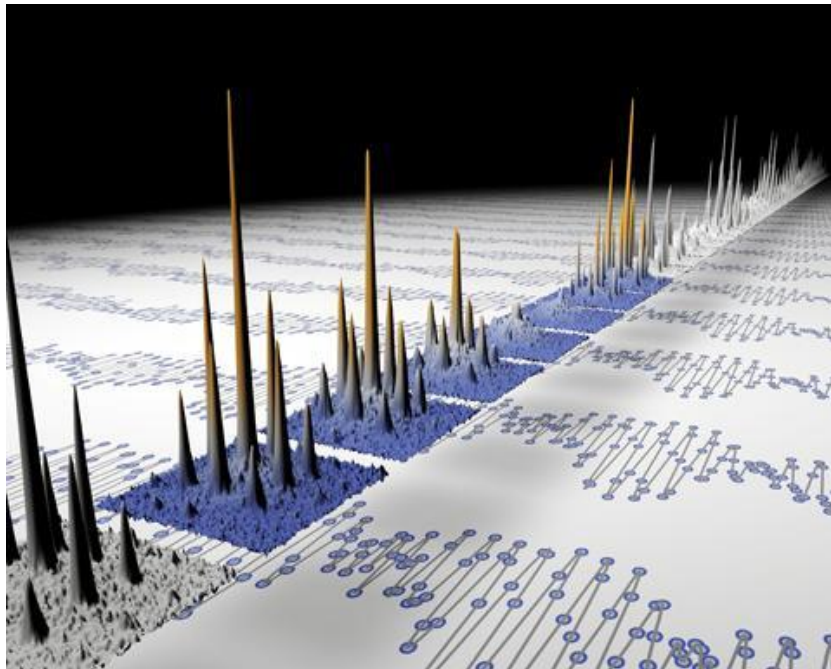
9.4 - LIGHT, MATTER & THE AETHER

“Matter may be and likely is a structure in the Aether but certainly Aether is not a structure made of matter” – Joseph Larmor, 1900

- As far back as Poseidonius, forces pervading all of space were postulated. Alexander of Aphrodisias spoke of an all pervasive fluid, a “pneuma”, through which all forces would act. Al Kindi spoke of forces as entities propagated by “rays”. Bacon called them a “species” that propagated through the medium. Those attempts at understanding what Einstein would call the “Spooky action at a distance” were precursors of our concepts of fields.
- Newton himself was of many minds on this, occasionally proposing “Ethereal Spirits”: “And now we might add something concerning a certain most subtle spirit which pervades and lies hid in all gross bodies; by the force and action of which spirit the particles of bodies attract one another at near distances, and cohere, if contiguous... But these are things that cannot be explained in few words, nor are we furnished with that sufficiency of experiments which is required to an accurate determination and demonstration of the laws by which this electric and elastic spirit operates”. Elsewhere, he says: “Gravity must be caused by an agent acting constantly according to certain laws; but whether this agent be material or immaterial, I have left to the consideration of my readers”.
- Newton proposes a “Hypothesis” (insisting still on his doubts): “It is to be supposed therein, that there is an aetherial medium, much of the same constitution with air, but far rarer, subtiler, and more strongly elastic... For the electric and magnetic effluvia, and the gravitating principle, seem to argue such variety. Perhaps the whole frame of nature may be nothing but various contextures of some certain ethereal spirits or vapours, condensed as it were by precipitation, much after the manner vapours are condensed into water, or, exhalations into grosser substances, though not so easily condensable, and after condensation wrought, into various forms, at first by the immediate hand of the Creator, and ever since by the power of nature, which by virtue of the command increase and multiply, became a complete imitator of the copy set her by the protoplast. Thus perhaps may all things be originated from aether”. Those same Ether particles he proposed as the

explanatory principles for optical phenomena and numerous other physical processes.

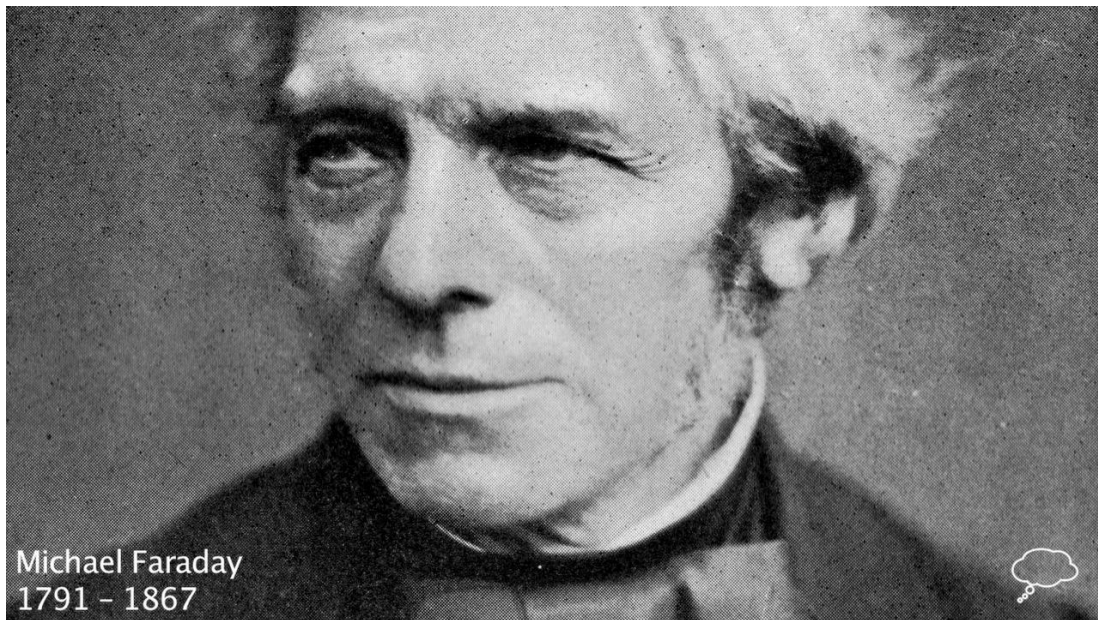
- The great Euler, after mulling alternatives, conceded “the whole space which separates the heavenly bodies is filled with a subtile matter called aether”, to which it “seems more reasonable to ascribe the mutual attraction of bodies to an action which the aether exerceies upon them, though the manner of acting may be unknown to us, than to have recourse to an unintelligible property”.



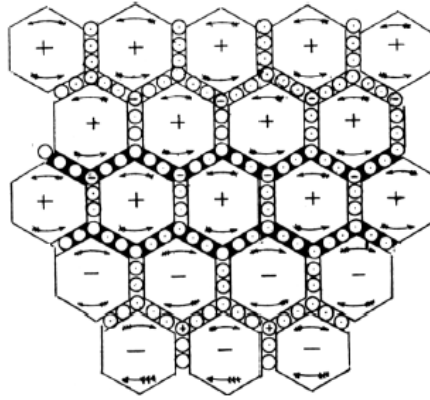
- While Einstein’s Special relativity did not need an Ether to explain the phenomena, and popular accounts speak of his “banishment of the Ether”, Einstein never directly addressed the need or lack of the Ether. Modern thought looks at the Cosmic Background Radiation as the backdrop framework for our Universe, an Ether by another name.
- Einstein (1919) also assumed the energy momentum Tensor T was due to Electromagnetism – an assumption driven by his hypothesis that electrically charged particles were held together by “gravitation” or a similar geometric construct – the beginning of his life-long attempt at unifying gravity and electromagnetism.
- Einstein hoped for a “fusion” of undulation and corpuscular theory, a “theory of light” so interpreted. “It is not just a few who hope that matter can be reduced to purely electromagnetic phenomena”. Faraday

earlier suspected the final irreducible constituent of reality was the electromagnetic field. Ziegler and Planck thought that a basic particle of light (invisible little spheres) would explain all interactions of matter and electromagnetic phenomena, erecting a bridge between the material and immaterial world. Einstein agreed, thinking a large number of quanta of energy would compose a vector field that would resemble our radiation, explaining the phenomena of interference and the wave/matter duality. Planck thought those Quanta could be seen as “atoms of action”, in their clusters providing the Electromagnetic phenomena we see.

- Faraday, Oersted, Ampere and the EM pioneers were driven by “views regarding the unity and convertibility of natural forces” (Tyndall), reflecting a Kantian view of the unity of nature. The identity of magnetism, electricity, light and EM waves confirmed their view, and has been the driving force for further unification efforts. There are enough hints that this is a possible goal, more than was apparent in Faraday’s days.



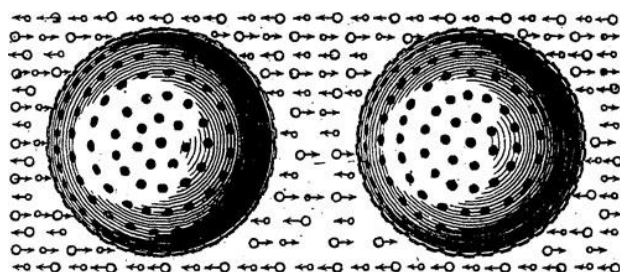
- In Maxwell’s days, and late 19th century, most physicists thought the fundamental ingredients of the universe were based on Electromagnetic waves- Light. Einstein ached to get rid of those pesky particles, and derive it all from waves, even though he ultimately drove science in the opposite direction with his “photon” particle theory.



- Maxwell himself derived his famous (and still unchallenged) equations from the concept of an electromagnetic Ether hosting the EM field. The equations he set up for the Electro-magnetic field were inspired by those for a Fluid. While later approaches disparaged the Ether (it was unnecessary for Einstein's approach, but he did not disavow it), different versions of the Ether are prominent in many new approaches to our understanding of space. Maxwell had imagined whirling molecular vortices supporting the flow, with spin rate proportional to the local magnetic intensity. His "Fluid" analysis, using "Flux", streamlines, and Potential all led to his equations, which we use today while ignoring his method of formulation. But the fact that the concept derives (and was actually initially derived) from a Fluid flow model should hint at the possibility of a PL Fluid model, and will ensure that model will survive the mathematics.
- The Indian Buddhist (Dignaga in the 5th Century, Dharmakirti in the 7th) developed a Philosophy about **reality being composed of atomic entities that are momentary flashes of light or energy**. They viewed light as being an atomic entity equivalent to Energy.
- Spencer saw a mysterious something at the back of the evolutionary drama we witness – an unknowable force producing known phenomena. "We come down then finally to Force (Energy in the terminology of his day), as the ultimate of ultimates. Though Space, Time, Matter, and Motion, are apparently all necessary data of intelligence, yet a psychological analysis shows us that these are either built up of, or abstracted from, experiences of Force. Matter and Motion, as we know them, are differently conditioned manifestations of Force (Energy)."



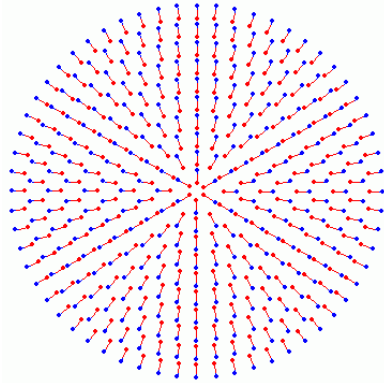
- A popular model of the 18th century was Le Sage's "gravitic fluid" model, where an infinite number of "ultramundane particles" of transcendent minuteness and exceeding speed (our PLs??) was assumed to traverse space in all directions in straight lines. While the idea as formulated failed to explain gravity with all its complications, the simplicity of the model attracted wide interest.



LeSage's Ultramundane particles

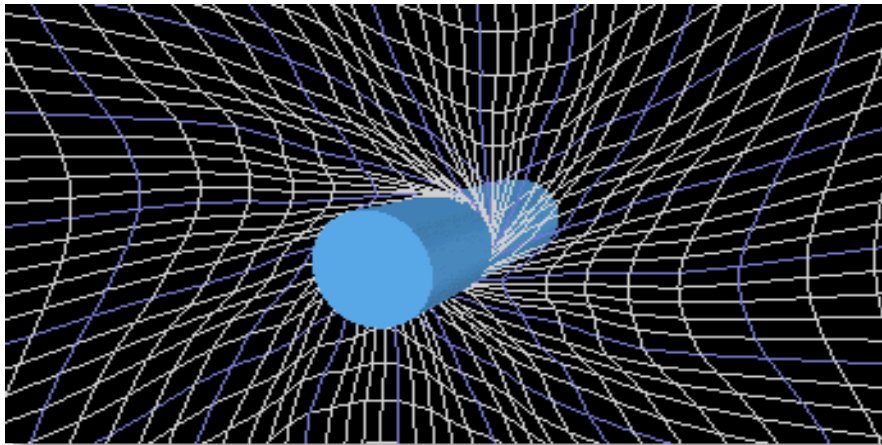
LeSage also proposed an optical, light-carrying medium called "Elysium", which simulated GR's effects via refraction, because gravity makes the medium denser near masses. It is amazing how many scientists considered this mode- JJ Thomson toyed with a similar model using radiation, as did Lorenz. Lord Kelvin tied it to his vortex theory, and Peter Guthrie Tait called it the only plausible explanation for gravity. Others like Keller and Boisbaudran built analogous "wave" models. Maxwell, with his insight and dry humor, thought the theory has taken "more space... than it seems to deserve."

- The mathematical genius of John Bernoulli envisaged a torrent of a "copious and impetuous rain of pellets" (PLs?) that interacted with particles and vortices.



- Hertz, J.J. Thomson and many others explained “potential energy” as “concealed masses and their motion”, similar to the Kinetic energies of visible masses. This is our “extra PLs” concept, above the minimal particle configuration, that result in its motion (those pesky dancing partners again). Spiller also thought that Force has to be conceived as an all pervading “quasi-material presence” residing in the omniferous all-permeating ether. Hertz also pre-supposed invisible things behind the things we see, “confederates concealed beyond the limits of our senses”, so that we may “conjoin with the visible masses of the Universe other masses obeying the same laws, and of such a kind that the whole thereby becomes intelligible and conformable to law”. Hertz thought it necessary to account for electrodynamic forces, gravitational forces, and all action-at-a-distance effects, as well as mechanical forces, by some mechanism of concealed masses and motions.
- The Principle of Least Action, an old concept that came back to life with Feynman in his sum-over-histories of QM, says energy will move from one configuration to another in the least possible time... Our Pilot PLs concept affords that “guidance” for the unconscious energy in that exercise, the “wave” arriving first at a point guiding the path to that point. Hertz had postulated that “every natural motion of an independent material system is such that the system follows with uniform velocity the path of minimum curvature”
- The concept of Force as a mathematical tool, unreal and unnecessary when we look at the world as a geometric construct, has been expounded by many prominent minds, from Hans Vaihinger in his “as if” Philosophy, to Henri Poincare, who (in his “Science and Hypothesis”) called it an anthropomorphism artifact from our pre-mordial infancy. Karl Pearson, in his “Grammar of Science”, calls it a “fossil from the

spiritualistic explanation which sees in will the cause of motion. The notion of Force as that which necessitates certain changes or sequences of motion, is a ghost of the old spiritualism". Tait sees it as "no more an objective entity than say five percent per annum is a sum of money". Dubois-Reymond calls it an "abstruse product of the irresistible tendency to personification which is impressed upon us". Once we see the world as an emanent space, and the resulting apparent "forces" a result of the geometry and dimensions (combined with a least action principle mediated by entangled pilot waves), the need for "Forces" and their con-commitant "force particles" goes away. Mach, Hertz and Kirchhoff all agreed in removing this unnatural appendage, useful as it had been as a mid-wife in the elaboration of mechanical processes, a middle-term that serves its function, but is not needed or present in the final result.



- One recently suggested model for "existence" is a photon model, using the "Ethereal Shear" concept, Maxwell's "Stresses in the Ether" revisited. Another is the Ethereal Foam. These are parallels to our "PL Pressure" idea. Much earlier, Lord Kelvin had conceived of "Vortex atoms", being vortex rings in the Ether of many distinct types and persistent nature, while Helmholtz looked for cyclical systems of concealed motion, demonstrating that "vortices exert forces on each other, and those forces take a form reminiscent of the magnetic forces between wires carrying electric current". A superfluid Universe is foretold.
- Lorentz's dream (pursued in many forms by Poincare, Dirac, Wheeler and Feynman) was to get the electron's mass entirely from its electromagnetic fields, with the energy in the Coulomb field accounting

for the inertia. The diversion of QED moved them away from this pursuit. QED, a perturbative approach with lots of cancellations due to renormalization, made the analysis much more difficult.

- Newton's Opticks (first published in 1704) described Newton's corpuscular theory which says that light corpuscles ('Rays') generate 'Waves or Vibrations' in an 'Aethereal Medium', like a stone thrown into water generates water waves. In addition, it is supposed that waves in turn affect the motion of the corpuscles which 'may be alternately accelerated and retarded by the Vibrations'. In particular he thought that effect of the medium on the motion of corpuscles was responsible for interference and diffraction: "And doth not the gradual condensation of this Medium extend to some distance from the Bodies, and thereby cause the Inflexions of the Rays of Light, which pass by the edges of dense Bodies, at some distance from the Bodies?" For diffraction to occur, motion of corpuscles must be affected at a distance by the diffracting body. Also, to account for coloured fringes in diffraction of white light by opaque bodies (Grimaldi), corpuscles would have to execute an oscillatory motion: "Are not the Rays of Light in passing by the edges of and sides of Bodies, bent several times backwards and forwards, with a motion like that of an Eel? And do not the three Fringes of colour'd Light above mention'd arise from three such bendings?" David Park would humorously write: "Science still awaits the mathematical theory of the Eel." ☺
- Back to Einstein (always!): "the concept seems to me most natural, that the existence of electromagnetic fields of light is connected as much to singular points as the existence of electrostatic fields to the electron theory. It cannot be excluded that in such a theory the total energy of the electromagnetic field might be regarded as localized in those singularities, exactly as in the old action-at-a-distance theory. For instance, I consider each such singular point as being surrounded by a field of force, which possesses essentially the character of a plane wave, whose amplitude decreases with the distance from the singular point. If many such singularities are present in distances which are small with respect to the range of the field of force of a singular point, then the fields of force will superpose and form in total an undulatory field in the sense of the present electromagnetic theory of light." Elsewhere he continued: "It (Light) shares further...the property with a corpuscular theory of light to transmit inert mass from the absorbing to the emitting body". "According to Maxwell theory, the magnetic field of a moving

electric charge represents inertia. Why not then the *total* inertia? Then only field-energy would be left, and the particle would be merely an area of special density of field-energy. In that case one could hope to deduce the concept of the mass-point together with the equations of motion of the particles from the field equations – the disturbing dualism would have been removed.” “Between the material particles there is empty space, the seat of electromagnetic field, which is created by the position and velocity of point charges which are located on the material particles.” Further, “the atoms should only radiate... electromagnetic but also gravitational radiation, though in tiny amounts.” (our PL waves). “... in the foundations of any consistent field theory, there shall not be, in addition to the concept of field, any concept concerning particles.”

- Max Born, in defending his “probability” interpretation of Schroedinger’s equation, quotes Einstein: “he said in effect that waves exist only to guide the path of the corpuscular light-quanta and he talked in that sense about a “ghost field”. This determines the probability that a light-quantum which carries energy and momentum follows a certain path; to the field, however, no energy and no momentum belongs”.
- The electromagnetic conception of matter was widely explored by Joseph Larmor, Wilhelm Wien, Max Abraham and Henry Poincare. Poincare saw mechanical mass as nothing else than electromagnetic mass, and that electromagnetic mass is not a static fixed quantity, but depended on velocity. Larmor worked on understanding the atomic structure of matter in terms of electromagnetic fields as early as 1893, with ideas of vortex atoms and vortex electrons in the sea of the electromagnetic field. Electrons were seen as rotations in the electromagnetic field, constituting stable, stationary configurations that correspond to given discrete values of angular momentum. His ideas provided an explanation of atomic spectra and predicted the Zeeman effect.
- Larmor in fact gave the first physical meaning to Planck’s constant, as a ratio between matter’s electromagnetic field energy and radiation frequency, being a quantum of conserved angular momentum related to the electron vortices in the electromagnetic field. His ideas lead to the cells in space-phase for quantized radiation, which Nicholson used for explaining atomic structures, leading to Bohr’s model. For Larmor, the discrete, discontinuous, quantum nature of matter and radiation is easy to understand if matter is derived from electromagnetic fields, also

explaining the dual wave and corpuscular nature. Unfortunately, Bohr and Sommerfeld picked up the thread, without the electromagnetic background, and turned the quantized solution into a mathematical construct devoid of the EM interpretation.

- Larmor had seen Planck's statistical thermodynamics of electromagnetism as implying that classical electromagnetism continuous variables lose meaning and cannot be accurately measured, but only probabilistically measured in relation to matter corpuscles created from the EM field. Poincare saw that mechanics must be intrinsically probabilistic, if the origin of matter is electromagnetic and EM radiation is discontinuous. Even Heisenberg saw the EM roots of his uncertainty relationship. Unfortunately, this EM conception was eventually lost in the structured matrix formulation of the new Quantum Religion.
- Born & Infeld further contemplated an electromagnetic structure of matter, with their Blons (carrying electric charges) and Dyons (Julian Schwinger's hypothesized particles, carrying electric and magnetic charges) being essentially electromagnetic representations of matter. Their proposals have seen a recent revival.
- De Donder, in trying to extend Schroedinger's wave equations in special relativity, found the gravitational interaction in general relativity had solutions that imply a periodical phenomenon that resembled the undulatory behavior of microscopic particles in Schroedinger's wave picture. He went on to derive the quantum-theoretical behavior of an electron moving simultaneously in gravitational and electromagnetic fields, finding the non-gravitational (EM) part coinciding with Schroedinger's equation. Oscar Klein had found a similar connection between Kaluza's dimensional approach for tying electromagnetism and gravitation, and the wave approach of De Broglie and Schroedinger.
- Max Born, following a hint from Einstein, had suggested that the wave field associated with radiation guides the corpuscular photons like a "ghost-field" (Gespensterfeld), this field being Schroedinger's wave. "The guiding field represented by a scalar function Ψ of the coordinates of all particles involved and of time, propagates according to Schroedinger's differential equation. Momentum and energy, however, are transferred in such a manner as if corpuscles (electrons) do actually rush around."
- Bjerknes and Korn, in approaching the interactions of electrons and particles in quantum mechanics, used an analogy to hydrodynamics,

where, in a weakly compressible fluid, two spheres pulsating with the same frequency attract or repel each other with a force inversely proportional to the square of their distance, whose sign depends on whether they vibrate in phase or in opposite phase.

- Gustav Mie's electron was a "'nucleus' which goes over continuously into an 'atmosphere' of electric charge" which "extends to infinity, becoming extremely thin in the neighborhood of the 'nucleus', so that one cannot detect it experimentally in any way". Compare that to Bohm's particle with associated real wavefunction. Mie's theory highlighted that electric and magnetic fields exist inside the electron as well, and that "the hitherto known states of the ether, namely the electric field, the magnetic field, the electric charge, and the charge current are entirely sufficient to describe all phenomena in the material world."
- Marcer, Mitchell, Rowlands & Schempp took the lead from thermodynamics, quantum and classical dynamics to propose the Universe as a Quantum Carnot Engine (QCE), where elementary particles with quantum coherence create a state of "matter" called "phaseonia", whose first instance is Zenergy, the empty ensemble of Dark Energy. The work is inspired by Rowlands' Nilpotence concept, where the Cosmos is seen as an empty set/nothing/zero, based on a generalized derivation of Dirac's equations. This Zenergy is "imprinted" with the 3+1 space-time field and its quantizations, and providing space-time's elementary sources and sinks. It is seen as a universal topological pre-space, connected quantum mechanically in a non-local fashion.
- Osborne Reynolds (1902) conceived an ether of miniscule particles, unobservable in their normal state (our PLs?), with deviations from the normal distribution appearing as material particles (our PLCs?).
- In his development of QED, Dirac had proposed the concept of spurious, unobservable photons – Zero state photons with no energy and momentum. "When a ligh-quantum is absorbed it can be considered to jump into this zero state, and when one is emitted it can be considered to jump from the zero state to one in which it is physically in evidence, so it appears to have been created". It is a small step from here to our PLCs continuously diving into the Netherworld. Dirac spent much of his life, after his major accomplishments with the Electron equation and antimatter, trying to "sort out" QED, suggesting continuous streams of matter, a "bag model" of an extended electron (reused later for

hadrons), picturing the electron as a “bubble in the electromagnetic field” with the muon its lowest excited state. He insisted that an Ether is necessary for the description of elementary particle – a velocity field, “a very light and tenuous form of matter”, “this state of the aether, combined with the absence of ordinary matter, may well represent the physical conditions which physicists call a perfect vacuum”, allowing us to re-introduce absolute simultaneity. Sounds like a PL field to me.

- Rothwarf sees a sea of electron/positrons, a super-fluid of degenerate matter-anti-matter. Particles are vortices in this superfluid, electrons circulating in the vortices in their ZitterBewegung. Pauli’s exclusion principle being the repulsion of aligned spinning vortices. He notices also that standard theory views frequency and oscillation as a transition between positive and negative energy states (as we detail in our view of anti-matter). He smartly pictures the generation of the photon (a spin-off from the electron vortex) during the electron’s drop into a lower orbit or energy level, and ties the frequency and duration of the emitted photon with the kinetics of that process, as we have proposed in “the measure of a photon”. He also views mass as an electromagnetic mass, in multiple guises. His view of state reduction is an analogy of the ball settling once the roulette wheel is stopped.
- Pauli: “In a future theory, the action function probably will not at all decompose into several independent, separated items: I rather expect a unified conception of matter, electromagnetic and gravitational fields.”

All those thoughts are furtively calling for a new concept. With the mainstream physics world a closed corral of String theorists and dogmatic Copenhageners, the field is left to amateur scientists and free-thinkers. LaViollette reaches out to chemical analogies in his subquantum Mechanics proposal, where a series of Ethers (equivalent to dimensions, with gradients of density determining forces and motion) populated by tiny Etherons (akin to our PLs) “react” (a-la- Brusselator and the Belousov-Zhabotinskii reactions, Prigogine’s dissipative structures, with spontaneous self-organization and Turing waves generation) and coalesce to produce matter and energy (those being simply concentrations of the Ether), in a “continuous creation” process within the Akashic field! It refutes the Big Bang (a “macho” creation concept), favoring a gentler, more nurturing “feminine” creation principle ☺. Besant and Leadbeater saw “ultimate physical atoms” (u.p.a, also called anu ☺). Ranzan proposed his DSSU Cellular Universe. Meno proposes Gyrons as the ultimate

corpuscles in a fluid universe analogy (with the Gyron concept latched onto by many others for similar proposals, e.g. Kyriaczi). “Physics on the Fringe: Smoke Rings, Circlons, and Alternative Theories of Everything” has a field day with this. Weizel’s Zeron did not excite Heisenberg. One in desperation suggested a “Theory of Something (TOS)” instead of a Theory of Everything (TOE), with Negtrinos (not far removed from our PLs ☺) being the key component of Nature.

A resonance of ideas does not a proof make. But a common thread of ideas, from many a learned mind, points to an attractive recurring concept, one that seems to revive itself in new garb with every generation. Perhaps the next revival may hit on a cogent proof. After all, atomism is as old as the Greek antiquity, but had to be rediscovered many times, once our maturing science caught up with that radical concept, 2500 years later. It may be that a synthesis of apparently conflicting ideas is what is needed- as Ken Wilbur says, no one is smart enough to be completely wrong, and therefore, to one extent or another, “everyone is right”. Somewhere out there, the right idea is waiting to be found.



“It is impossible to conceive anything without a cause; the attempt to do so makes the mind a blank. This implies that there must be a great many scientists walking around with blank minds” – H.P. Blavatsky (an Einstein favorite ☺)

“What we observe as material bodies and forces are nothing but shapes and variations in the structure of space. Articles are just schaumkommen (appearances). The world is given to me only once, not one existing and one perceived. Subject and object are only one. The barrier between them cannot be said to have been broken down as a result of recent experience in the physical sciences, for this barrier does not exist.”

– Erwin Schroedinger (“On Quantum Theory”)

Fichte, the absolute idealist philosopher of the 18th century, thought that “(an object) ... is nothing else but the ***totality of relations*** (of the object) ***unified by the imagination***, and that all these relations constitute the thing; the object is surely the original synthesis of all these concepts. Form and matter are not separate items; the totality of the form is the matter...”; an insight foreshadowing Bohr’s “Objective reality”. Everything is “thought”. But thought, the “intellect”, “has no *being* proper, no subsistence, for this is the result of an interaction and there is nothing ... with which the intellect could be set to interact. The intellect is an act, and absolutely nothing more; we should not even call it an *active* something, for this expression refers to something subsistent in which activity inheres.”



In this philosophy, the Universe is a computer (minus the hardware), a huge program, and we subroutines in that program. A logical, Digital universe would be the program, “hardware”, logic and all. It is an abstract program, an “Absolute Idea”, of the same nature as the Human intellect or program. It does not need underlying hardware, and can be regarded as an abstract sequence of mappings from one input set to another, driven by logic and mathematics. “Consciousness” is just a unique subprogram evolved within this Universal Program. Schelling and Hegel extrapolated these ideas, maintaining Ego = everything, and everything = Ego, the Universal Ego. In Schelling’s view, our “Consciousness” programs would, in the fullness of time, evolve into one self-

knowing Mind, a Universal Self-Consciousness, a self-aware Universe. For Hegel, this is the purpose of human history. Schelling identified this Absolute Ego, the Universal Program, with God, who thence becomes an evolving entity – God as *Life*, not a mere *being*. This notion of an evolving God, according to Arthur O. Lovejoy, introduces us to evolutionary Metaphysics. As Schelling puts it: “I posit God, as the first and the last, as the Alpha and the Omega; but as Alpha He is not what He is as Omega”, God starting as “Deus implicitus” and ending up as “Deus explicitus”.

Pantheism was (and remains) a common philosophical interpretation of God as Nature. An evolving Nature implies an evolving God. A Digital Nature, driven by logic and Mathematical Rules implies Nature as a program. Intelligent life evolving within Nature implies a self-aware subroutine in that program. “The thought itself is the Thinker” (James). The Totality of those programs, the Universal Program, would be the Universal Mind, the Absolute Ego – aka God.



“God is a mathematician of a very high order, and he used very advanced mathematics in constructing the universe.” – Dirac

***“The Great Architect of the Universe now begins to appear as a pure mathematician” -
Jeans***

11 - UNREASONABLE EFFECTIVENESS OF MATHEMATICS

"It seemed to be a superlative thing – to know the explanation of everything, why it comes to be, why it perishes, why it is."- Socrates

Nature is a "Book written in Mathematical Characters" - Galileo

Wigner's perplexion deserves a closer look.

As we "discover" or "invent" (your choice) new mathematics, we find that nature has usually beat us to it already. Complex Yang-Mills theory? Got it. SuperSymmetry? Been there. Multi-dimensional String vibrations? Done that.

Is M-theory, Maldacena's conjecture, Yang-Mills Theory just mathematics or real Physics? And when more than one theory or duality describes the same picture, is it a word game or a real duality?

To answer this, let us look back at our proposal for creation.

In a world created through Logic, the binary Logic of existence, we start with the rudiments of Mathematics. Physics and Mathematics are born together. There is no "matter" material, but a logical construction.

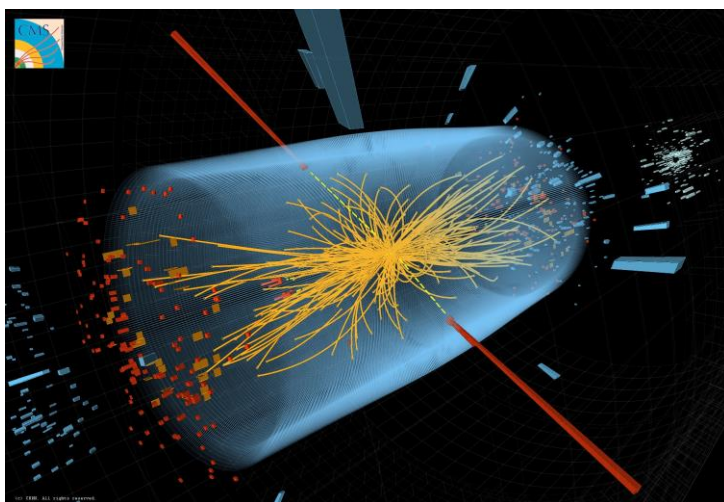
So when another PL shows up at the first location of another PL, two things just "happened": The amount of "matter" has just increased (physics), and "Addition" has just been invented. When that PL moves to another node, the number of PLs at the first node decreases (physics), and subtraction is invented. As the happenstance logic of creation evolves, the PLs will play out all kinds of combinations, and their resulting "configurations" present new "rules" or "possibilities". Mathematics and Physics are being created simultaneously.

So are those extra "dimensions" real or ephemeral "mathematical" tricks? What does it mean to be "real" in this case, to paraphrase Bohr? If we choose to see the PL Configurations as structured in multiple dimensions, based on our overall view of their interactions, then for all practical purposes they are. That means we have all just agreed with Nature that extra dimensions are there – and we have co-invented with Nature their concept- Nature by building the configuration in its Hilbert Space, and us by "theorizing" the concept in our minds. Given that our minds are also constructs of the same

Nature, with those configurations already built in, then Nature probably gave us the original hint anyway.

In that sense, Bohr may be justified in considering Science as being responsible for describing what can be said about nature, and not about “why”- Since “Why” is the result of the Logic playing out all its possible hands, and only when it generates a configuration that we can somehow interact with and measure, does it become relevant to us.

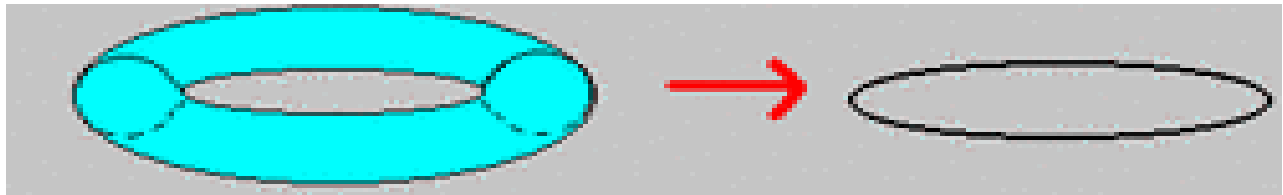
In that sense, we probably live in a world of endless possibilities, with every possible mathematical conjuring trick we can imagine eventually materialized by Nature somewhere. As such, all these are “real” in a sense that they “exist” somewhere, but may be “unreal” to us if they present configurations we cannot access (i.e. they are incompatible with our imagined 3 dimensional world view).



As we approach the finer details of existence, and as our “science” starts to probe those hidden spaces and dimensions, a Fields Medal winner like Witten could be just as useful (or more) than a Physics Nobel Prize winner. He could help “read” Nature’s mind, and what she has already discovered, at the same time giving Nature a voice to eloquently describe her latest invention. When more than one formalism can represent the same “physical” truth, it may not be a question of either/or... It may be that the formalisms are both generated together with the Physical truth, and the choice is in the eye of the beholder.

The one thing we have learnt is that Nature is an economical student, who often reuses the lessons she has learnt. Condensed matter Physics shows

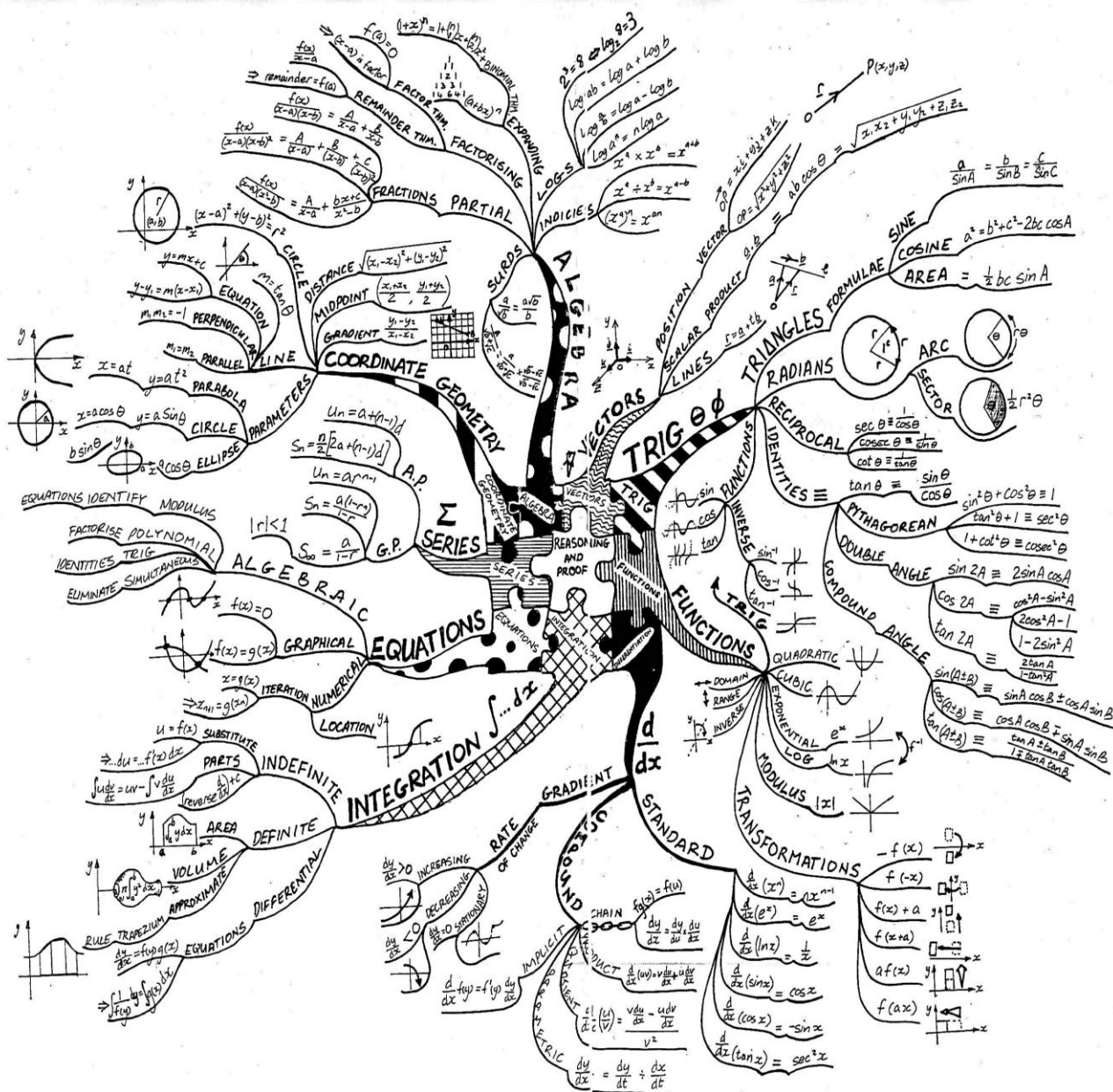
many phenomena that present a “scale invariance” similar to the conformal symmetry of String theory. Many phase transitions exhibit similar behavior, at all scales. They also show behavior where their n -dimensional aspects seem to be derivable from simplified/compactified $n+1$ dimensional systems. Lo and behold, String theory seems to exhibit the same behavior, leading ultimately (with the Maldacena Conjecture) to a $3+1$ dimensional view that can simulate the effects of all the higher dimensions, while ignoring their “existence”. Are those dimensions then “real” or simple mathematical crutches? As long as both formalisms lead to results that match our “observations”, the beholder decides. Maldacena in fact proposed that the two scenarios are identical in results, and the fact that the other dimensions are “too small” for us to see is irrelevant- The “Physical laws” (i.e. what we can “see”, or what our conscious senses correlate) are the same in both conceptions.



In Eleven Dimensional M-theory, the fundamental objects are described by a Matrix (one of the possible reasons for the M... other than Marvelous, Mysterious, or Mythical ☺), whose operations are non-commutative, with funky Grassman Algebras (that somehow allow for differentiated “handedness” of nature) and other special features. The resulting behavior then simulates Strings and Branes in ten dimensional Superstring theories, which then simulate the behavior of our familiar particles and forces in our beloved $3+1$ dimensional world. As T.H. White wrote, “Anything that is not Forbidden is Mandatory!”, and who is to forbid Nature!? The PL computer runs the simulation, and we, at the end, using the GUI screen provided by our EM visual sensors, see the simulated results (Science fiction, of course, takes it a step further, letting Aliens run the simulation – some even proposing simulations running simulations, in infinite regress!). Whenever possibilities exist, Nature will try to take advantage of them. Consistency, “the hobgoblin of small minds”, is not Nature’s strong suit.

The PL fluid logical motions and combinatrix result in the world structure we observe (as well as those we don’t). It is only limited by its “Mathematics”, and since it generates its Mathematics as it goes along, it is unlimited. The

Mathematics we know is a small subset of the Mathematics Nature has discovered/invented, one layer in Wigner's onion. There are more Wonders in that world than is dreamt of in our Formulae.



"The mathematical lawfulness of nature is the revelation of divine reason. The world is not chaos, but a cosmos harmonically ordered by inviolable mathematical laws."
- Weyl

"It would be revealed, to the fame of the mathematician and to the boundless astonishment of the rest of mankind, that mathematicians, purely in their imagination, have created a large field to which one day the fullest real existence should be scribed (though it was never the intention of these idealistic fellows)." - Minkowski

10.1 - THE WORLDS OF MATHEMATICS

If the search for a unified, UNIQUE theory of the world is not successful, as aptly demonstrated by the failure of String theory, then perhaps that is an indication that there is not one unique theory.

Relativity works well at the large scale. Quantum Mechanics works at the very small, but assumes a flat space-time background. Between them, they answer most of the questions we have about the world we observe. Most, but not all.

At the very very small (Planck Length), and the very very large (Universe), their applicability becomes questionable.

Going back to String theory, we find a consistent theory that results in an incredibly large number of possible solutions. And it is not even the only mathematically consistent theory around (Loop Quantum Gravity, etc.). They all result in a huge number of possible worlds with varying Gauge groups, coupling constants, cosmological constants, and the like.

So the True Believers of each theory threw in the towel, and abandoned the search for a Unique Theory. Apparently God DID have a choice in making the world – a Lot of choices, and He chose not to choose, but instead built them all! Out came the Landscape of String Theory, the Many Worlds of Everett, the inflationary Multiverse of Guth, and a myriad other sets of possibilities.

Enter Max Tegmark.

His “Ultimate Ensemble Theory” postulates: “Physical existence is equivalent to Mathematical existence... Mathematical existence is merely Freedom from contradiction.”

Any world that is mathematically possible IS, period. The logical world we proposed in our PL picture plays out all possible scenarios, creating those worlds that are consistent with its logic. They are “out there”, “pi in the sky” (Barrow) worlds, akin to Plato’s ideal structures. All they need for existence is “limited by the requirement of self-consistency and by the identification of the isomorphic ones.” Our World is just one of those worlds.

Empirical proofs are out of the question here. Those worlds are in their own hyperspace, physically and causally unconnected to ours, and we can never reach them. This is a meta-physical concept, out there to contemplate, not to

measure. It is suggested by the large set of available consistent solutions, and motivated by the fine-tuning that seems to be required for our own anthropic existence. But these are merely suggestions, not proofs. This may not be fully acceptable for a scientific theory, but this is where the road has led. An untestable proposal is hard to falsify, but it is a “low cost” proposal, even if we had to take the expensive String Theory Road-Trip to find it out.

Our PL world scenario plays into this as a possible description of “our” world, which also allows a “visualization” of how the various other worlds come out of the Hilbert Space. It gives them a common origin in logic, which allows the power of mathematics to expand and develop them. Since they would be separate ensembles in the Hilbert Space, they would be unreachable to us, and hence untestable. But the picture remains, and that may be all that is allowed to us.

This “Ultimate Ensemble Theory”, a new and interesting take on the “Theory of Everything”, “postulates that all structures that exist in a mathematical sense, exist in the physical sense as well” (Tegmark). This is essentially our proposal, simplicity in itself. Logic and Geometry, the two pillars of Mathematics, create the world and create its rules. Our job is to find the rules for “our world”, which are a subset of those rules. For the other worlds, IF they can sustain self-awareness, then those self-aware entities there will have to look out, measure “their” world (possibly with a whole new and strange perspective from what we are used to), and figure out its rules. For us, it is just an interesting mind game what they do, with no practical consequences.

Einstein thought that “the creative principle resides in Mathematics”. Existence is in the logic, without the need of “hardware”, and as Minsky thought, “the Universe simply doesn’t “exist””, a simulation in the mind of God. If that Mathematical simulation contains “observers”, to those observers it “exists” Physically – they observe themselves, therefore they exist; Cogito, ergo Sum. Leibnitz’s “pre-established harmony” between mind and matter, and Hermite’s tripartite harmony between mind, mathematics and the physical world, is a simple byproduct of the fact that they are one and the same. Rowlands could derive Physics from a nil-potent mathematics (start with “nothing”, add a create and conserve operator, always ensure zero-sum, stepping through conjugation, complexification and dimensionalization, and pronto – you get an infinite universal “alphabet” congruent with the nilpotent

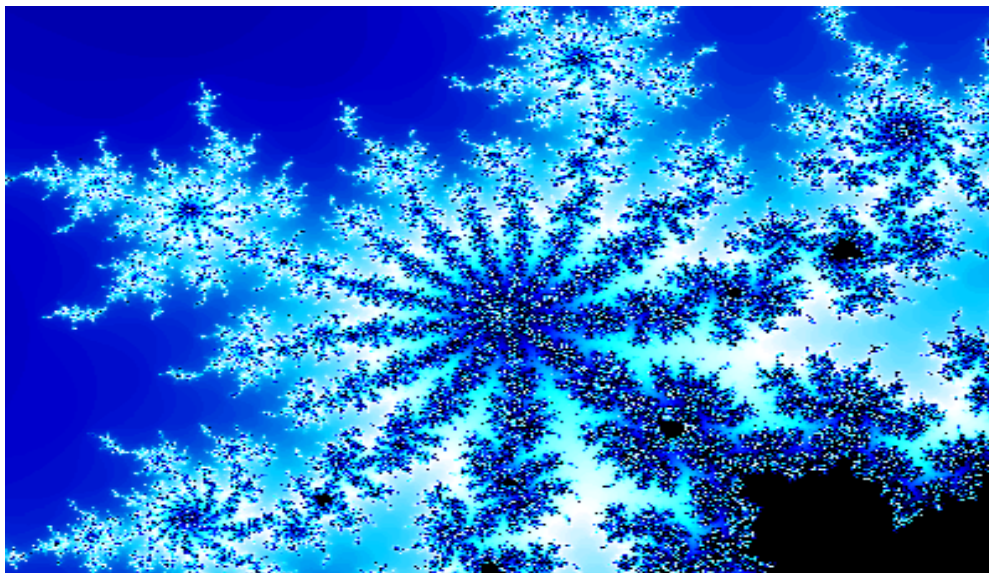
generalization of Dirac's quantum mechanical equation), and Stein Johansen can explain all information processing in nature from the Fibonacci series. Its from bits.

For Wilczek, Quarks are more than particles: they are “embodied ideas”, “mathematically complete and perfect objects”. “You can’t fiddle with the equations without making them worse (indeed, inconsistent).” “Implementing an idea leads to a candidate reality... The candidate reality, hatched from ideas, is reality itself.” “Gluons are the objects that obey the equations of Gluons”! Euler’s Beta function meets Chew’s S-Matrix needs, and can describe strings, strong interactions and much more. Quarks, Neutrinos, W & Z bosons were all discovered “Mathematically”, theoretically, before they were found in nature – Nature obliged when the Math required it. Our “Fore-sight” came from our understanding of the Mathematics involved – which “required” those particles. First came the equations, then the particles. Recently the Higgs particle showed up in the LHC, but Higgs had “required” it decades earlier. Dirac needed anti-particles, and Anderson’s positron obliged a year later. Axions are “required” (to explain the tiny CP violations of QCD), but are late to the party. Dirac’s “discovery” of the anti-particles is legend – his equations, though, gave him no choice. Similarly Maxwell’s equations foreshadowed Electromagnetic radiation (radio wave, microwaves, infrared, ultraviolet, X-rays, Gamma rays, things we never knew about before), which Hertz, Roentgen, Rutherford and others found many years later. Yukawa’s pion waited for Cecil Powell & Occhiliani several decades later. Chadwick found Rutherford’s Neutron 12 years after the thought conjured it. The Standard Model expected neutral vector mesons and the Omega Minus particle, and sure enough, they came calling. When Isidore Rabi quipped “Who ordered that?” (at the discovery of the muon), the answer should have been: “We did!”

Did we just anticipate reality by understanding it? Or is reality a Mathematical entity, that solves the equations, and *is* the solution of those equations? Penrose harkens back to Plato’s ideal realm: “To me, the world of perfect forms is primary ... its existence being almost a logical necessity – and ... the world of conscious perceptions and the world of physical reality are its shadows”. The recent progress of Science seems to be telling us that we now are approaching the Mathematics of Nature, and hence Nature itself. We may even discover more ways for Nature to do the same job (like Matrix Mechanics, Wave Mechanics, or Dirac’s transformations), even though she

might have picked only one. But we also have to be careful not to come to hasty conclusions – imagine Buford Price proudly proclaiming detection of the elusive magnetic monopole in cosmic ray events, only to have Alvarez demonstrate the same result observed could be due to a platinum nucleus decaying first to osmium and then to tantalum. What luck! But the mathematical formalism of observables for both events apparently coincide, even though they are widely divergent phenomena.

There would be no single “Theory of Everything”, no *Weltformel*, no “Field Equation” of everything whose solutions we are. “Even if such a theory exists in some platonic sense, what justifies the hubris which assumes this theory can be captured by the human mind? Maybe, the best we can do is to cover various patches of experience by local charts, which work well in their realm of validity, but which cannot be extended to the whole of reality” (Stig Stenholm). Our “constants of nature” would be statistical in origin. There would be the simple rules of logic, building up Mathematics, which build out structures. A “Game of Life” (pun intended) in progress, a fractal world of fascinating wonder coming out of very basic rules. That is why we find Nature repeating her tricks at every level- She is using the same Mathematics, and the same simple rules – Gregory Bateson’s universal Meta-Patterns a good example. She loves redundancy, creating three groups of leptons and hadrons, just because! The layers of the cosmic onion keep unfolding, the lion’s tail of Einstein telling of the lion on the other end.



$z = z^2 + c$ – Go Figure!

“Creation is never completed. Though it has once started, but will never cease. It is always busy in bringing forth more scenes of nature, new things and new worlds” (Kant).

In a Computable Universe, ***almost*** anything goes, and the principle of plenitude and Eddington’s principle of identification, inferring physics from mathematics, rules. “Anything that *can* happen *does* happen” (Robinet, 18th century). It is a version of Jorge Luis Borges’ “La Bibliotheca de Babel” gone wild, a place where Nozick’s “all-encompassing multiverse” (Greene) is realized. Our “Constants” of Nature may be slowly varying, a symptom of an imperfectly uniform Nature, or an indication of many algorithms leading to the same “apparent” constant. We must attribute “reality” to those theoretical entities, and not just the empirical entities we have already seen. In time, we produce new technologies and devices that “realize” those options in Nature that we had not seen lying around before. We are, in a sense, become helpers of Nature in its creative endeavor, helping the “great chain of being” (Leibniz) expand into the space of potential beings. As Alexander Pope would say of Newton’s Principia:

Nature and Nature’s laws lay hid in the night,

God said, let Newton be! And all was light

As the incomparable Gamow glibly said, expounding on his arch-nemesis who had solved the unlikely missing carbon-isotope that explained the creation of the heavier elements: “God decided to correct his Mistake in a most impossible way. And God said: “let there be Hoyle”, and there was Hoyle. And God looked at Hoyle... and told him to make the heavy elements in any way he pleased” – and Hoyle obliged with the B2HF. In Fuchs’ “sexual interpretation of quantum mechanics”, “there is no one way the world is, because the world is still in creation, still being hammered out.” Capra, describing Chew’s Bootstrap approach, calls it “a fundamental principle of an approach which does not accept fundamental principles”.

The deeper we search, the closer we get to reality itself, the more abstract seems our world. This conundrum simply points to the Mathematical nature of Nature. This is where Mathematics provides the inventive role of clarifying the abstractions and discovering the real world – Nature’s Code. Bohr was wrong in this regard, as Heisenberg noted that he “would not like to say that

nature imitates a mathematical scheme, that nature does only things which fit into a mathematical scheme". Heisenber wondered: "Is it true, perhaps, that only such experimental situations can arise in nature as can be expressed in the mathematical formalism?". In Wheeler's "participatory Universe", the Universe adapts to us as we adapt to it. "The Cogs in the Machine have become the Creators of the Universe" (Zukav). "The mathematician plays a game in which he himself invents the rules while the physicist plays a game in which the rules are provided by Nature, but as time goes on it becomes increasingly evident that the rules which the mathematician finds interesting are the same as those which Nature has chosen" (Dirac).

But not *everything* goes. As Bunge says: "Every empirically testable theory must be interpreted before we can hope to test it: we must know what it is about – and that is all that is meant by "meaning". In short, meaning is necessary though insufficient for testability, and the latter is sufficient though unnecessary for meaning". "It is theories, and only theories, that enable us to interpret empirical operations". While "to be is to be measurable", it is good to remember that "our predecessors made accurate measurements of properties of nothings, such as the caloric, and that hundreds of our contemporaries are probably measuring properties of fictive particles."

Liebnitz adds: "In order for a being or a possible to be able to exist it must be non-contradictory." For Democritus, beyond names, appearances and measures, true physical objectivity is given by the "idea". "The criterion of judgements for the scientific research is the concept". Chew insists that (in his Bootstrap approach) "you want to derive everything from overall self-consistency". We should keep in mind, however, Liebnitz' caveat: "With no argument at all it is possible to demonstrate in an absolute way that bodies exist and nothing can prevent us from thinking that the objects of our mind are well-ordered dreams that are deemed by us as true and practically equivalent to the true ones thanks to their correspondence." Unlike T.H. White's dictum in "The Once and Future King", it is not always true that "Everything not forbidden is compulsory." For one thing, we are never sure what is not forbidden. Time Travel, which some laws of Physics allow, must find a censor, to avoid its various paradoxes (Grandfather Paradox, Information Paradox, Bilker's Paradox).

And while we may never be able to know everything about Nature, we can know enough to make use of her. “The Maps we have allow us to navigate over large areas of the ocean of knowledge” (Stenholm). We have been able to do a lot so far with partial knowledge, and we will do a lot more with a little more knowledge. Coulomb’s law, valid today, was coined before we knew of atoms, electrons, and much else. Dirac, who has contributed so much just by “playing around with mathematics”, had said: “I rather early ... got the idea that everything in Nature was only approximate, and that science would develop through getting continually more and more accurate approximations but would never attain complete exactness.” Heisenberg compared his approach to how “some mountaineers look upon a tough climb. All that matters is to get over the next three yards. If you do that long enough, you are bound to reach the top”. Dirac did pretty well with his piecemeal strategy and that attitude. Capra and Chew agreed that “the approximate nature of science is generally accepted” now.

If something comes out that doesn’t match “our” assumptions (like, say, Parity violations), we shouldn’t assume like Pauli & Dirac that “God must have made a Mistake”, or, as a Swedish report declared, “the laws of nature are wrong” if they violate CP symmetry. While ideas are “refined by ingenious men and women into a logical pattern... Nature, of course, carries this pattern in her bones” (Marburger). Nature, Fourier said, “is indifferent toward the difficulties it causes mathematicians”. As Gould would say in another context, “almost every interesting event in Life’s history falls into the realm of contingency.” Contingency is destiny, and Nature does not necessarily function in a “Natural” manner. Finally, a world that all of us, and not just the Einsteins among us, can understand!

“Today there is a wide measure of agreement, which on the physical side of science approaches almost to unanimity, that the stream of knowledge is heading towards a non-mechanical reality. The Universe begins to look more like a great thought than to a great machine.” - James Jeans

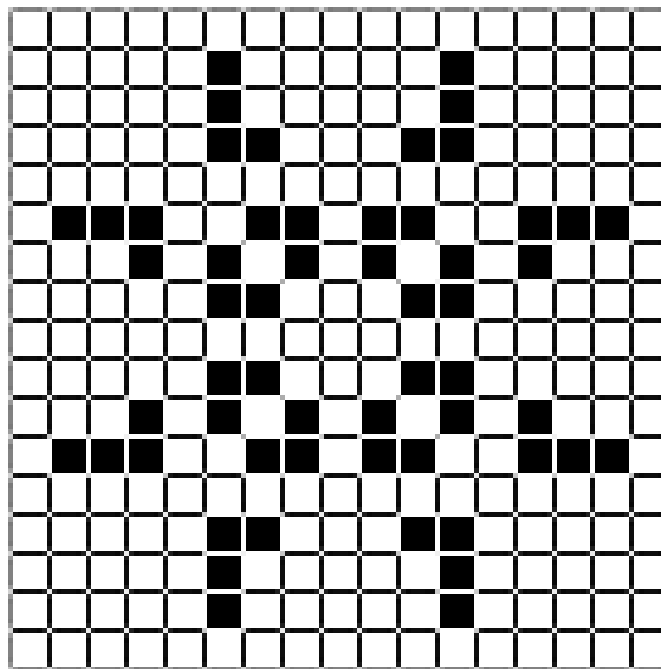
“Who would have imagined describing something so much a part of the here and now as gravitation in terms of the curvature of the geometry of space? ... Little astonishment there should be ... if the description of nature carries one in the end to Logic, the ethereal eyrie at the center of mathematics.” - John Wheeler

“... the ground of reality first became transferred to the laws of physics themselves, ... to treat the physical universe as if it simply is mathematics. Many of my theoretical

physicist colleagues do indeed regard ultimate reality as vested in the subset of mathematics that describes physical law. For them, (this subset of) mathematics is the ground of being". - Paul Davies

"God exists since mathematics is consistent, and the Devil exists since its consistency cannot be proved." - Hermann Weyl

"Mathematical existence is synonymous with physical existence. ... Maybe math is reality. ... Our reality is nothing but math. In this way of thinking, everything you're aware of - the sensation of holding this book, the thoughts you're now having, the plans you're making for dinner - is the experience of mathematics. Reality is how math feels. ... there's no distinguishing what we conventionally call the mathematical description of reality from its physical embodiment. They are the same. There's no switch that turns math "on"." - Brian Greene



Game of Life

Any live cell with fewer than two live neighbours dies, as if caused by under-population.

Any live cell with two or three live neighbours lives on to the next generation.

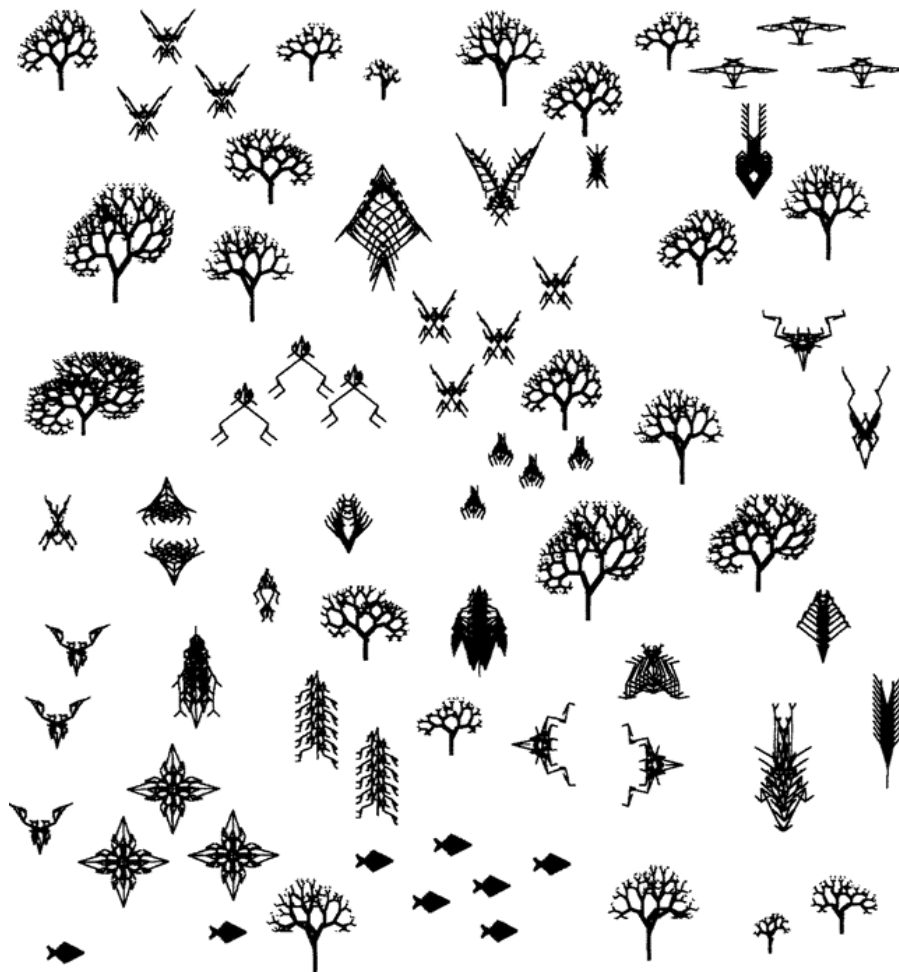
Any live cell with more than three live neighbours dies, as if by overcrowding.

Any dead cell with exactly three live neighbours becomes a live cell, as if by reproduction.

The initial pattern constitutes the seed of the system.

10.2 - ANTHROPO-ESCAPES

You can divide this Everything, these myriad worlds, into two classes: Those that allow a “self-aware substructure” like ours, where sentient beings can “see” and analyze this creation, and those worlds that don’t, where they may exist but nobody sees them. This last set is in a sense irrelevant: We cannot reach it, and nobody inside can see it – it is a “dead” world. It may be existent, but it is not Real (see our definition of real later). Obviously, any world with a “self-aware substructure” (intelligent life) must have passed the consistency criteria, since life may **arise out of** chaos (non-linear systems providing ample opportunities for variety) but cannot **survive in it**. Such a world provides, in Tegmark’s words: “The answer to Hawking’s question: “What is it that breathes fire into the equations and makes a Universe for them to describe?” would then be “YOU”, the self-aware substructure.” The “relevant” physical existence for us then becomes any mathematical structure that allows self-awareness, which will “perceive itself as existing in a physically real world”.



So our Theories of Everything simply become ways to parametrize the infinite possibility of worlds, a “catalogue” of sorts, but one that does not allow predictions or new insights, not even into our own world. String theory may be one of those theories, and its landscape the catalogue – but it may or may not cover all sets of possibilities. Once we see a new feature of our own world, we just add it to the description in the catalogue. The catalogue simply lists the various “contingencies” that make up the “options” our world happens to possess, out of the infinite set of possibilities.

This does not mean that Science stops. We have already identified some basic rules our world seems to have (Gauge theories, the equivalence principle, etc), which have led to domain-specific rules (Quantum Mechanics, Relativity) that we can apply to decipher more sub-rules and phenomena. We have been doing this since Archimedes, Galileo, Newton and all the greats. In this sense, we retain some predictive power. We may also discover more such generic rules, that will further expand our sphere of knowledge of our world. But there will always remain a set of contingent parameters that we have to find empirically, and they are associated with the initial conditions and accidents of our creation. And there will be “practical” limits to our observations, that may limit our ability to see deep enough in order to explain some of the theoretical disconnects we see (like those between relativity and QM). While we labor to push those limits, we can still accept the current theoretical state as a reasonable approximation, the simplest current mathematical solution, of the observables and phenomenology we can access. Already, the Standard Model explains much of the world, with a relatively small set of parameters (contingency factors?), and other ideas (Rowlands’ Zero to Infinity) can build the logic of the rules and gauge theories from scratch. We are not helpless.

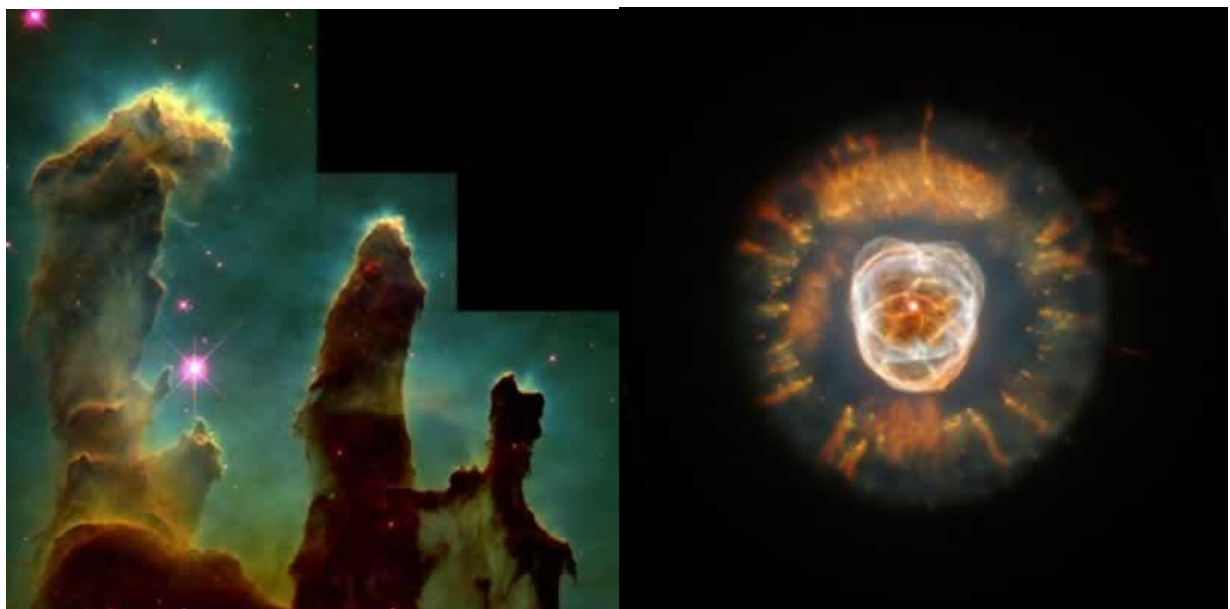
We can also go one step further, and analyze the various contingencies that might still allow intelligent life, and therefore expand the set of possible “live” worlds, the “archipelago” of self-awareness (which we may find to be finite, given the many vagaries life has to go through), even though we may not be able to visit anything but our island in it. We can start with what we know about our world, and extrapolate from there to the limits that allow life. This may not identify the whole set, but is the best place to start. It is also not an easy problem. “It is nearly impossible to say: the weak anthropic principle (the requirement that we find ourselves in an environment or neighbourhood which can support life) requires the cosmological constant to be ... the fine

structure constant to be ... the strength of inflationary fluctuation to be ... The problem is simply too complicated.” (Dine). “It is likely that the low energy dynamics of any theory satisfying our criteria would be sufficiently complicated that we would have little chance of deciding whether complex, intelligent organisms could evolve in these alternative universes.” (Banks). We have to be careful with Anthropic arguments (“incredibly imprecise and easy to squirm out of”, says David Gross). We will have still a lot of work to do, a lot of grants to spend, and a lot of theories to muster. It is not THE END.

Gross summarizes the anthropic approach as such: “Unlike other principles in physics, it thrives on ignorance. Other physical principles in physics get stronger the more we know, yet the anthropic principle gets stronger the less we know. Once we know something, especially if we know it precisely, it disappears completely from the realm of anthropic arguments. Anthropic arguments might be necessary, but they fly in the face of the success of physics over the last few centuries. Hopefully they will not be required.”

One may feel a sadness that Science’s grand quest for the “why” – why the world is at it is, why was it built this way, “why it has to be the way it is (Weinberg)”, is no longer achievable. “Because” is an unsatisfactory answer we often tell our children, and it must feel uncomfortable to have the Universe tell us “Because” as an answer. But you can look at this two ways: Contingency may be frustrating, but it is also an opening to infinite diversity.

“There is no law except the law that there is no law” – J. A. Wheeler



10.3 - IMPOSSIBLES

"A Paradox is truth standing on its head to attract attention" - Nicholas Falletta

"Nothing is too wonderful to be true." - Michael Faraday

Once we accept the world as a mathematical construct, then we have to accept what the math tells us.

And some of the stories Math tells are pretty far out.

Some of the stories are hypotheticals, in the sense that they may apply "somewhere", but not in our world. They could describe other possible worlds, but not ours.

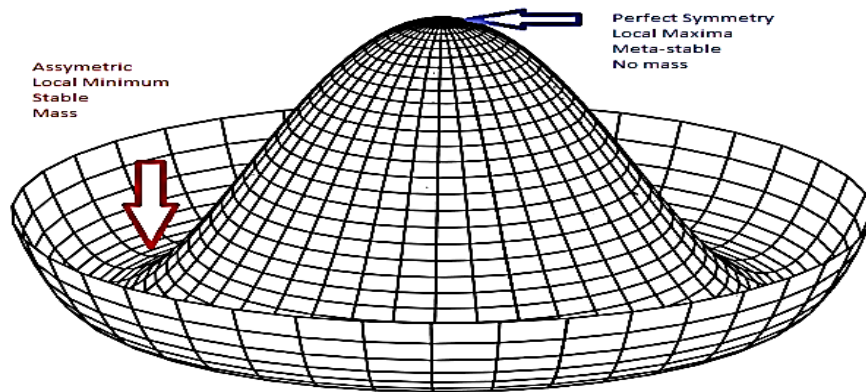
Other stories apply to our world, but seem very un-intuitive. Here we have some ways of checking the story: If the RESULT meets with our observations, then it could be true. If it doesn't, we recheck the Math.

I say it "could be true" because a story, while its results can be verified, may have also happened a different number of ways with the same results. I can tell you a feasible story about how the cup in front of you got to be broken. If the cup is broken (which you can verify), then my story is plausible, but not necessarily the right or only one.

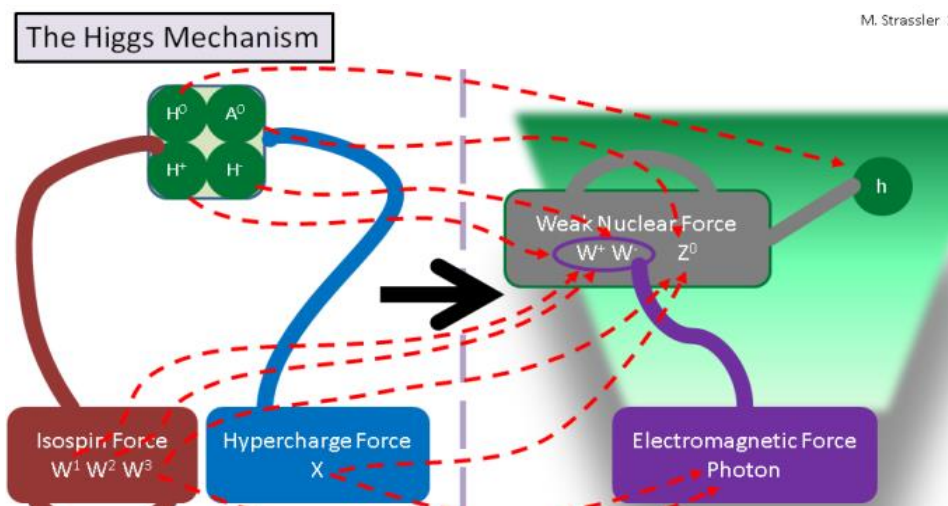
Here are a few "impossible" stories from the Mathematics that seem to match our observations, but not our common sense:

- **Tachyons**, those particles that supposedly go faster than light, and who go faster the more they interact with matter and lose energy! They come with "Imaginary" Mass (i.e. their mass is a multiple of i , the square root of -1). They have never been observed in Nature so far.

The Math says, however, that the "Inflaton", which started the initial Inflation in the Big Bang, is a Tachyon. The initial "vacuum" of the Big Bang was a "False" Vacuum, meaning it was at a higher energy than the ultimate "True" Vacuum, so the Tachyons destabilized it, creating bubbles in the False Vacuum, and causing inflation in the process. As our world inflated, the Tachyons disappeared, which is why we do not see them now. They still exist outside our bubble, possibly causing other bubbles to inflate into alternate Universes.



The Math also says those Tachyons turned into the Higgs Particles, which were recently found in the LHC in Geneva. These are the particles that give “matter” its mass, the ones Leon Lederman called “The God Particle”. They are a linchpin of the Standard Model of Particle Physics, the last missing item in the menu. Story Verified?



The Math starts with a wild idea, calculates a scenario, that is then verified indirectly in the Lab. As Feynman repeatedly said, there may be more than one way to tell the same story and get the same result, but this is one story that works, and the results are verified.

In our PL world, the Tachyons would be the very high density PLCs in the singularity, whose “Pressure” is high enough to cause an “explosion” in Space node formation, unlike the normal steady state space expansion, resulting in “faster than light” expansion of the PLC. As the Space matrix expands, and the density is lowered to the normal “Photon world” density, normal EM propagation starts, and now matter (and Mass) can initiate.



The Impossible is Plausible!

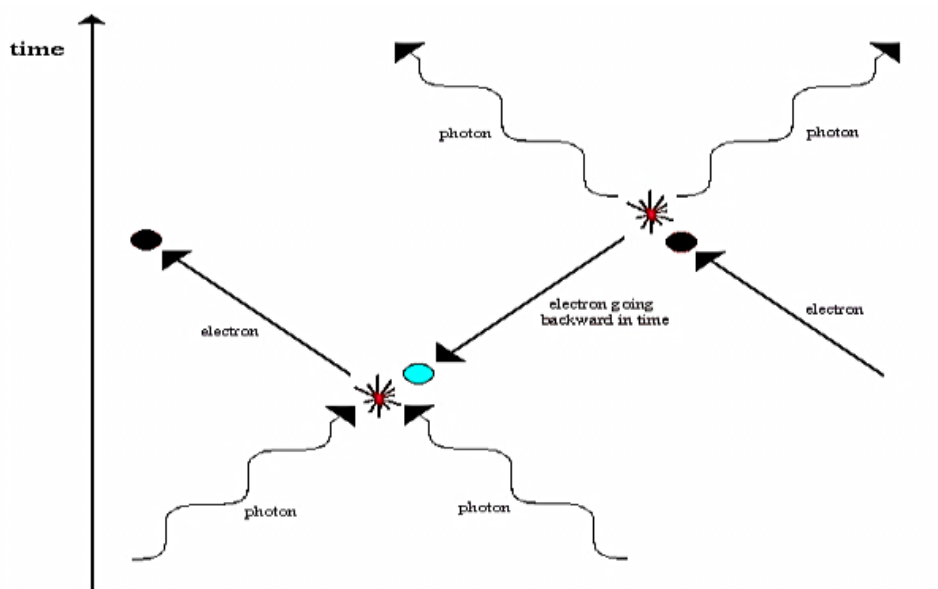
- **Advance Waves from the Future!**

Feynman and Wheeler, no slouches both, in trying to explain the various effects of QED (before its final formulation), saw an obvious item in the Mathematics of Maxwell's equations: they contained a solution involving EM waves going back in time, as if coming from the future. Many had seen those before, and ignored them as mathematical curiosities. The "Retarded" (no offence) waves of the solution (the well behaved ones moving forward in time) provided all what they needed for normal every day classical EM problems, and the "Advance" waves seemed a redundant mathematical artifact.

But then those funky waves met a funky Physicist, who wouldn't let go of something so curious. After being done building atomic bombs and picking locks at Los Alamos, he analyzed Dirac's equation, and found that if you reversed both time and the electron charge, the equation remains the same! An electron going backward in time is the same as an anti-electron (a positron) moving forward in time. A Mathematical slight of hand, or the actual motion of anti-matter? Feynman wasn't done yet.

Normally you look to your thesis advisor for some mature guidance here. As luck would have it, Feynman's advisor was the equally incredible and "out there" John Wheeler (an extra-terrestrial if there ever was one!). John agreed with the concept of the antimatter motion being equivalent to the electron going backward in time and went even further: It is the same electron, going

back and forth in time, that we see as all the electrons and positrons existing now! No wonder they all look alike!



Feynman suggested that charges interact “half through the advanced and half through the retarded waves. It turns out, most surprisingly, that in most situations you won’t see any effects of the advanced waves, but they do have the effect of producing just the radiation reaction force. The radiation resistance is *not* due to the electron acting on itself, but from the following peculiar effect. When an electron is accelerated at the time t , it shakes all the other charges in the world at a *later* time $t' = t + r/c$ (where r is the distance to the other charge), because of the *retarded* waves. But then these other charges react back on the original electron through their *advanced* waves, which will arrive at a time t'' , equal to t' minus r/c , which is of course just t The combination of the advanced and retarded waves means that at the instant it is accelerated an oscillating charge feels a force from all the charges that are “going to” absorb its radiated waves.”

To make a long story short, this view, when extrapolated, ended up as QED, the theory guiding our technological progress today, verified to within one part in 10 billion by experiment. Those “advance waves” seem necessary to protect causality (!? You would have thought coming from the future would violate causality) by cancelling the right terms in the retarded waves, and fit fully with the QED model. Feynman compared his love of them to falling in love with a beautiful girl as a youth, that girl now the matriarch of our science.

A more recent model for a photon packet built by this combination of advanced and retarded waves (PRAHM mode, Packets of Retarded and Advanced Helically Modulated modes) can possibly explain phenomena of entanglement in a classical way.

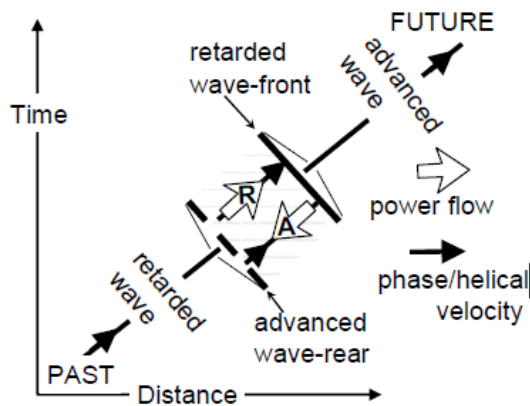


Figure 6

Schematic formation of PRAHM mode: Packets of Retarded and Advanced Helically Modulated modes creating a resonance. The advanced wave feeds back power to maintain resonant state with retarded wave carrying power forward. The packet travels at the group velocity.

In our PL world, we explained the positron and electron moving apart, their light formations clicking in a reverse configuration of each other, to maintain the original symmetry. The reverse clicking of the positron would be interpretable as traveling back in time. The FTL wavefunction would account for the apparent effects of the advanced waves.

The Future is here, and it is just as strange as the present!

And by the way, whoever said that Nature's mechanisms can only evolve within the realm of human intuition?? After all, our "intuition" is a product of Nature, a small subset of its work. Since when does the tail wag the dog? Not even if that tail was an Einstein or a Feynman! ☺ "The ground of Physics is littered with the corpses of unified theories" (Freeman Dyson), Nature winning with a vengeance.

There will always be mysteries beyond our understanding as we peel the cosmic onion. If Mathematics rules our world, and Godel proved that mathematics cannot be complete, then our world, our science, like our mathematics, is inexhaustible. As Stephen Hawking (an early String theory advocate who switched sides) says: "Godel's theorem ensured there would always be a job for mathematicians. I think M-theory will do the same for Physicists." Nature may be limitless, parlaying even a small number of rules and tricks into numberless possibilities, like a skilled chessmaster, and chaos theory and butterfly effects amplify her games. Our lot may be to live with just

“good-enough” theories, like General Relativity and the Standard Model, that explain enough of what we need, and slowly increase their scope to master ever larger patches of Nature, but never a “Theory of Everything”, never the whole Shebang. The flip side of this is that there will always be new discoveries, new worlds to conquer, and infinite possibilities.

Wilczek cautions not to use “contingency” as an early excuse to give up when we find an enormous number of facts we are unable to derive from a cohesive framework of generally applicable laws of physics. He instead points to “contingent regularities” of the “whole observable universe” as true contingencies. We are talking Physics here, not biology or history, where contingency is the rule.

The Sakata school in Japan, which found an early solution resembling the quark model, believed in the philosophical and mathematical “world within worlds”, aka onion theory, of nature, echoing the 12th century Sufi “The Macrocosm is the microcosm” philosophy. Anaxagoras had said: “Everything is in everything at all times”, while Al-Rumi thought “Behind every atom of this world, hides an infinite Universe”. Reality has an infinite set of layers: Galaxies made of rotating stars, Solar systems of rotating planets, atoms of rotating electrons, nucleons of rotating quarks, a fractal scenario ad infinitum. We see this as well in our PL world, but believe the logical PL as the end of the line. In between, however, many layers abound.

At the same time, we will learn to never say impossible – Kelvin was wrong when he declared we knew almost everything in the late Nineteenth century, as was Comte to declare the impossibility of knowing the heavens. Both absolutes are wrong, and harmful to the progress of science. Our search continues to probe the boundaries of the large and the small, in all area of thought. Godel’s Incompleteness theorem notwithstanding, Science is neither limited or inconsistent. A Logical world, made of bits that follow additive rules and geometric rules, can generate all of our Universe in its complexity. All we would need for it is Presburger arithmetic, and Godel does not play there. It doesn’t make it easier or less time consuming, but it removes Godel’s Damocles sword.

A Mathematical world is full of possibilities, limited only by our imagination. Hertz looked at the equations of Maxwell and wondered: “One cannot escape the feeling that these mathematical formulae have an independent existence

and an intelligence of their own, that they are wiser than we are, wiser even than their discoverers, that we get more out of them than was originally put into them.”

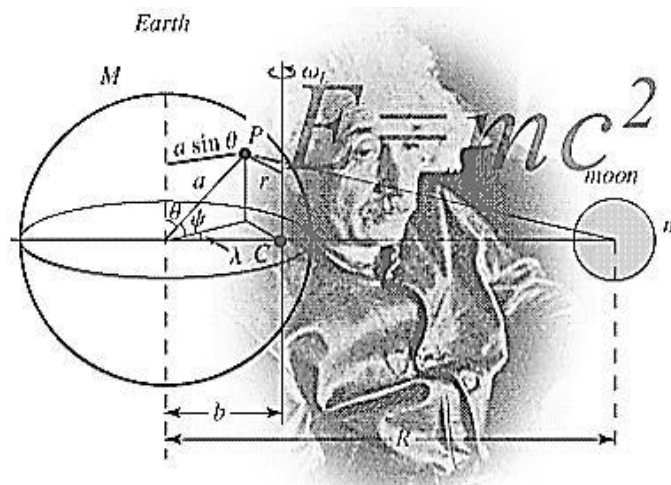
What is “impossible” today is tomorrow’s cellular phone or X-ray telescope. Pauli’s “particle that can never be observed” is observed daily at the Kamiokandi mines. It may take time – thousands of years for Democritus’ atoms, 2 years for Chadwick’s Neutron, but if it is out there, it will come.

“What God has torn asunder, let no man put together.” - Wolfgang Pauli (to Einstein)

“All impossibility theorems proved is a lack of imagination” - John Bell

“I don’t think that physics will ever have an end. I think that the novelty of nature is such that its variety will be infinite – not just in changing forms but in the profundity of insight and the newness of ideas...” - Isidor Rabi

“School Children during the mechanical age were readily able to accept the idea that the solid appearance of a table is an illusion; that the table was ‘actually’ mostly empty space, with tiny particles whirling around inside. How much easier will it be for future scientists growing up in the age of information, computers and flashing pixels to accept the idea of a world made of events and of potentialities for these events to occur?” - Stapp



“There is ... a possibility that the ancient dream of the philosophers to connect all Nature with the properties of whole numbers will some day be realized” - Dirac

“The aim of science is to make difficult things understandable in a simpler way; the aim of poetry is to state simple things in an incomprehensible way.” - Dirac

12 - GETTING REAL

“The price of gaining an accurate theory has been the erosion of our common sense.” - Richard Feynman, QED

“We conclude that both theoretically and observationally the universe (probably) exists”. – Dennis Sciama ☺

If a Tree falls in a Forest, does it make any sound? This old philosophical question has new meaning when we consider the nature of reality. Galileo mused: “there’s no tickle at the end of a feather” – it is there only if some one is there to sense it. According to the solipsist, life was a dream, which had no existence apart from the dreamer. I think, therefore I am, says Descartes.

If a PL comes in and out of existence without interacting with anything (any other PL), then does it qualify as “real”? Remember: there is no space for it to come into – it creates the space node when it shows up, but only to the extent that it has a relationship to other nodes, those relationships building “space” so perceived.

If a PL (or even a PLC) is “moving” through “Space” (read: its Hilbert space cluster is drifting together in the continuum), not correlated with other clusters, then as far as those clusters are concerned, it does not exist. It is not “real”. Reminds one of the joke about the first wrestler in a town – he had to quit because there was no one else to wrestle with. It takes two to Tango, as they say, and it takes more than one to get Real.

When those PLCs coincide – collide- correlate, then their relationships appear: They “measure” each other. As Heisenberg said: “If one wants to clarify what is meant by “position of an object”, for example, of an electron, he has to describe an experiment by which the “position of an electron” can be measured, otherwise this term has no meaning at all”.

So “Measurement”, as such, by “picking” on an otherwise isolated cluster, makes it “appear”, makes it real. This measurement could be an intentional experimental act, or a Hilbert-space correlation event that we would consider as “decoherence” when the PLCs collide. This “environmental” Decoherence effectively limits the “Freedom” of the PL, through interference/correlation. This correlation and limitation comes in degrees, depending on the impact and size of the cluster – those degrees showing up in a “quasi-reality”

appearance, the particle hovering between multiple states (as seen in experiments with “interfering” bucky balls or even larger molecules), until sufficient interference forces a “tight” formation into our full reality. As Laloe indicates, “generally speaking, it is different spatial localization that produces wave packet collapse”. Mathematically, a “non-linear localization term” in a modified Schroedinger equation, acting in $3N$ configuration space, results in the selection of one of the components of the decoherence basis. In another approach, discontinuous Markov processes in Hilbert Space reduce, in certain cases, to a continuous spontaneous localization, also tied to non-linear Schroedinger equations (aka Continuous Spontaneous Localization (CSL)-Girardi, Pearle & Rimini), that also allow for creation of identical particles. According to Jordan, every observation is not only a disturbance- it is a key to the creation of the field of observation: “We ourselves produce the results of measurement”.

“A strictly isolated object does not belong to the world, it is devoid of events. What we idealize as an isolated object is operationally defined by an interaction in the past and the possibility of measurement on it in the future. Thus it is a fact, i.e. a state vector” (von Weizsacker). “An event that is happening in the interaction of a small number of objects is apt to disappear again, i.e. not to become a fact. It is a still undefined event. We can speak of it theoretically but we cannot know it. It can be easily be described by combining its participant objects into one composite isolated object, that is as a non-event”. But “if an event distributes an amount of energy on many objects, its probability of being undone becomes extremely small. Then it can be said to be a fact”. “Thus we would say that events happen when things interact. They have probabilities which are described by the state vector”. “The lack of interaction with the environment is mathematically described by saying that there is a wavefunction of the single object ... which is smoothly developing”.

Decoherence impacts all objects, especially macroscopic ones, who attach to their environment by correlating themselves with any and all passing elementary particles, and in the process losing their own coherence, and merging into a coherence that describes the whole environment. The scattering of even a single particle can destroy the coherence between particle states after they separate. “Coherent superpositions tend to constantly propagate towards the environment; they involve more and more complex

correlations with it, so that they become rapidly impossible to detect in practice.” (Laloe)

Jordan described the “reduction” of QM (“Mere Magic but not Physics”, says Penrose quoting Hawkings) as a thermodynamic irreversible process, and Gunther Ludwig showed that the “metastable” statistical distributions of QM always converge to a “stable” state, that state representing the “rock” of reality against which other transient QM phenomena eventually coalesce under “measurement”. Classical Physics is the physics of the “stable” macrosystems, while QM describes the “metastable” transitions and evolutions of the microphysical world. Interestingly, the same QM rules can also be used to derive the statistical thermodynamic rules which guide the coalescence of macrophysical stable states. Nature has one set of rules, manifested differently for the large and the small. Daneri, Loinger, and Prosperi explored this idea to a satisfactory theory of measurement that removes the “ghost” from QM, which according to Leon Rosenfeld can “be stated in terms of simple concepts, referring directly or indirectly to common experience”.

Englert, Bjork et al have demonstrated that complementarity is not more fundamental than uncertainty when looked at from a Hilbert Space perspective. By defining what is called “Predictability” (P), Distinguishability (D) (of which path) and Visibility (V) (of interference effects), they demonstrated that $D^2 + V^2 = 1$ and $P^2 + V^2 = 1$ in relation to which-way experiments and other slit experiments. Englert, Scully & Walther had earlier shown that the loss of interference effects is not due to momentum perturbations, but due to entanglement with the measurement apparatus.

Reichenbach talked of phenomena (our macro-world reality) and interphenomena – “occurrences which happen between the coincidences (events), such as the “movement” of the electron”, which are “inferred” from “interpolations” within the world of phenomena. Quantum mechanics deals with phenomena, observables, and leaves the interphenomena to the mystery world. While the same laws of nature may apply to both, using standard logic seems to lead to conflicts with classical concepts of locality, action at a distance, and uncertainty. He concludes that a “normal” description of “all” interphenomena does not exist. Unless “normal” comes to include non-locality, multi-valued logic, and travelling backwards in time.

A good question is: why then would an “isolated” cluster, say an Electron, show up usually where we “expect” it? A good answer is: we “expect” it based on our “knowledge” of the drift of its cluster in the Hilbert space, that space being described probabilistically by the “Quantum” rules and its “wave function”, another name for the algorithm of drift in the continuum. Loyal Durand suggested that appropriate correlations between objects and apparatus observables “permit the translation of theoretical statements about the expectation values of abstract operators in Hilbert space, evaluated in the initial object state, into statistical assertions about the results which will be found in an ensemble of quasi-classical observations”. This is made possible especially since “peculiarly quantum mechanical effects are small relative to the accuracy with which classical observations may be made”.

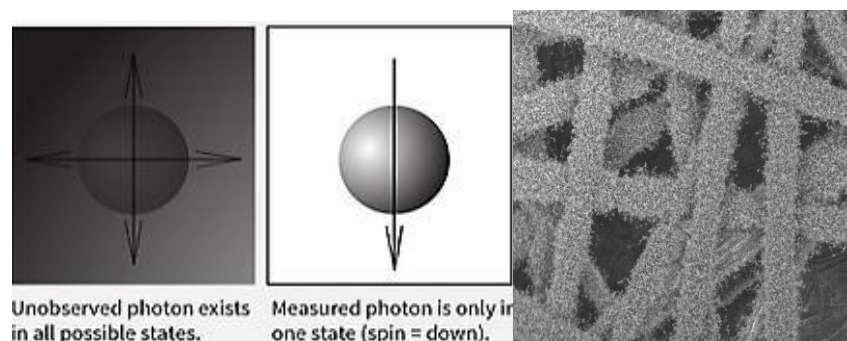
Margenau described this best, based on his review of the available evidence: What is “real” (in our terminology, “existent”) is the state function, whereas the classical observables such as position, momentum, or energy are “latent” in that function, in the sense that their values emerge (in our terminology, become “real”) only in response to measurement. Margenau saw this as an extension of Galileo’s & Locke’s ideas of primary and secondary qualities. According to Margenau, “they are ‘not always there’, that they take on values when an act of measurement, a perception, forces them out of indiscriminacy or latency”, comparing them to human qualities that are latent but evinced by events and experience. Even Heisenberg agreed that the state of a Quantum system prior to measurement is a “set of tendencies” comparable to Aristotle’s “*potentia*”, the measurement effecting a “transition from the possible to the actual”.

So the PLs exist (in/out of Netherworld), but become “real” when they interact. Observation is reality. Remember, it is our “perceptions” that construct the image of space from the PL Hilbert space, us being part of that space as well. Our “Perception” is the act of “inter-action” that brings reality along. We do not CAUSE the PL to show up, but by observing it, we make its existence known, relevant, and link it to the fabric... essentially bringing it into the fold, making it “real” – the PL is “realized”, perhaps an unwitting literal anticipation of the meaning of that word. The “inter-action” causes the cluster to lose some of its degrees of freedom – limiting its drift in accordance with the new environment it meets. That is the cost of being real.

This distinction between “Existence” and “Reality” is the clue to solving the Einstein-Bohr dispute. Existence is a necessary but not sufficient condition for Reality. Reality is Existence organized, correlated, brought to our Mesh. The PLs of an electron exist, but become Real when observed or interfered with. Isolated, they are like that sound in the forest.

This also helps explain the nature of non-locality. In Isolation, the electron is no-where and in no-time. It is out of the Mesh. Only when it interacts it shows up – in between interactions, it can be “anywhere” or “anytime”, although we can figure from what we have learnt about its Hilbert space drift (which we call “Quantum Mechanics”) the probability of its next show. Quantum physics is the science of the Hilbert correlations, the primordial “wave function” – Classical Physics is the science of the “Realized” world, the correlated, limited aspect of the Quantum world. In between is a murky domain of transition, where multiple versions show up and interference effects materialize.

It is not that the Photon had a “mysterious”, unknowable spin before we measured it. It is that the question had no meaning before we measured... Since there was no “up” or “down” in the isolated world of the photon before it interacted with the world. It is like asking a man (in a space-suit of course) drifting through empty space which way is up. Similarly for speed. In posing his EPR question, Einstein seems to assume an “absolute” space in which the particle moves. The PL space is not a neatly ordered mesh, at least not until its nodes interact. Its “relative” positions are disordered until we “measure” them, pinning them down to a sequence with our macro reality. Einstein, the discoverer of Relativity, wasn’t relative enough in this case.



The above may give us a “boundary” between the macro and the Quantum world. A Particle is “isolated” as long as it is not interacting. And with the CMBR radiation all around, that “free space” for isolation is restricted. With 20 trillion (2×10^{13}) photons criss-crossing a cubic meter, that free “mesh” space

is less than 10^{-5} cm wide; which is why we can see Quantum effects in bucky ball molecules and small bacteria, but not in larger objects. The CMBR ensures “decoherence” beyond that size, with 10^{11} background photons scattering off of a millimeter grain every second, dissipating the phase coherence on a timescale of about a nanosecond. This is also why it is difficult to build Quantum computers and isolate multiple atoms for that purpose. That is why the CMBR is the Universal Frame of Reference, the emanent “Ether” if you will. This frame provides a rough grid for space, while the finer resolution nodes remain unaligned, allowing for the mysteries of the Quantum.

An interesting aspect is thrown into perspective by this duality. “Time” is defined by our observance of Photons/PLCs in motion, interacting in the “real” world. Then the interaction between previously isolated quantum entities (where space and time are ill-defined) could take forms that look to us as violating locality (which they did not previously admit, being nowhere) and simultaneity (being previously on their own independent clock, or none really, since they weren’t doing anything – you don’t need a watch to idle ☺). This may explain some of the fuzziness of the Quantum-Classical interface, which we have been trying to pin down for about a century, the Jello not sticking to the wall.

A quote from Heisenberg: “We see that a system cut off from the external world is potential but not actual in character, or, as Bohr has often expressed it, that the system cannot be described in terms of classical concepts. We may say that the state of the closed system represented by a Hilbert vector is indeed objective, but not Real, and that the classical idea of “objective real things” must be here, to this extent, abandoned... The description of a fact can be effected in terms of classical concepts in just the approximation in which classical physics can be used. The mathematics of quantum theory can be used for this description as well, i.e. the boundary between the object in quantum theory and the observer who describes or measures in time and space can be pushed further and further in the direction of the observer... Knowledge of the “actual” is thus, from the point of view of quantum theory, by its nature always incomplete knowledge. For the same reason, the statistical nature of the laws of microscopic physics cannot be avoided.”

Pauli’s view is close. He views the Wavefunction of QM and “Natural Law” referring only to the “ensemble” description, in their interactions. “The

appearance of a definite position x_0 during a subsequent observation (for example, “illumination of the place with a shaded lantern”) ... is then regarded as being a “creation” existing outside the laws of nature, even though it cannot be influenced by the observer. The Natural laws only say something about the statistics of these acts of observation”. “As O. Stern said, one should no more rack one’s brain about the problem of whether something one cannot know anything about exists all the same, than about the question of how many angels are able to sit on the point of a needle. But it seems to me Einstein’s questions are ultimately always of this kind ☺”.

Einstein is oft quoted on this subject, partly because he is the grandmaster of Physics, and partly because he has thought hard and long about it, as the principal antagonist fighting the Copenhagen Orthodoxy.

The Criterion for Reality that Einstein, Podolsky and Rosen (EPR) postulated: “If, without in any way disturbing a system, we can predict with certainty (i.e. with probability equal to unity) the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity” is hence self-fulfilling in the sense that any confirmation of it requires observation, which by definition brings the Reality in. Both Bohr and Einstein were right – The world does exist as Einstein thought; Our observation brings it into “Reality”, as Bohr thought. Once realized, Einstein’s beloved classical rules hold (time, space, causality, even locality for those things we “observe”). Before it is realized, Quantum Mechanics, Bohr’s adopted Baby (neglected by its father Einstein), tells us of how it “might” be behaving, and where we “might” find it, based on our understanding of the probability rules and correlations of the Hilbert Space it is hanging out in when we are not watching. “Esse est Percipi” (Bishop Berkeley). Heisenberg thought “the term ‘happens’ is restricted to observation”. On the otherhand, the moon is always there when we are not looking (as Einstein asked and thought), because there is always someone looking – not necessarily people or “observers”. Its size (read large Hilbert Space domain) ensures it is always interacting with something “observing it”, “measuring it”, “realizing it” so to speak - not least the ubiquitous Cosmic Background Radiation (CBR). A mere mouse won’t do!

An “Object” is not merely a physical thing independent of its properties and relations. It is a functional correlation of properties, mathematically describable, that also describe its relationship to its environment. Observing it

is “theory laden”, as Hanson says. The question is not whether it is objectively existing or not, but how do we observe its existence, verifying it in the process. Experimenting with it helps – as Hacking liked to say, “So far as I am concerned, if you can spray them, then they are real.” If you can touch them, manipulate them, they are real. A Scanning Tunneling Microscope (STM) that allows you to move atoms and “feel” electrons assures you of their presence. Its use of “tunneling” to do so also gives an ontological reality even to the wave function itself – it is “a property of an electron just as truly as the blue color is a property of the sky” (Margenau). The existence of relational properties paints a dynamic picture of reality, which challenges us to paint a broader picture of what is real. The fact we described of a quantum particle “coming into focus” as it interacts with the observer means “the modern physicist can no longer countenance simple realism” (Henry Margenau). Entanglement further says that many properties are not “intrinsic”, but rather relational, and those relations are affected by observation. Lenz saw properties as either “given” (like mass) or “possible” resulting from “unions of particular qualities, complexities and relationships”, and that these latter were observer/experiment dependent. Margenau echoed this with his “possessed observables” and “latent observables”.

According to Stapp, the physical world is “not a structure built out of independently existing unanalyzable entities, but rather a web of relationships between elements whose meanings arise wholly from their relationship to the whole.” Between interactions (in isolation), a dynamic of unfolding possibilities occurs, described by Schroedinger’s equation in a 3D space for each particle (looking effectively like a $3N$ -D space for N particles), which “recollapses” into a single 3-D space picture when they are measured again. The “properties” of the particles, however, belong to their interactions. As Bohr said: “... an independent reality in the ordinary sense can be ascribed neither to the phenomena nor to the agencies of observation”, only to their interaction. Since everything in the Universe is always interacting, including ourselves, we can say the Universe is constantly “realizing” itself, a self-actualized entity.

“An elementary particle is not an independently existing unanalyzable entity. It is, in essence, a set of relationships that reach outward to other things” (Stapp). The development of the Schoedinger picture between relationships does, however, lead to a classical limit, which we see. “A long-range

correlation between observables has the interesting property that the equation of motion which governs the propagation of this effect is precisely the equation of motion of a freely moving particle" (Stapp). Bohm's mechanics assures that reality.

Einstein, who spoke of "the relativity of inertia", declaring the inertia or inertial mass of a particle depends on the existence of other masses and on their acceleration relative to that particle, perhaps foreshadowed this dependence on relative interactions to "realize" even the mass of the particle, without which interaction the concept is meaningless. As Spencer said: "Divest the conceived unit of matter of the objective correlate to our subjective sense of the effort, and the entire fabric of physical conceptions disappears".

Prigogine differentiated "Being" and "Becoming". "Events" that leave no permanent records are illusions, and only irreversible actions – interactions which involve a chaotic macroworld, force the otherwise ephemeral "elementary" particles into "Becoming" the essential components of the primary Reality. "The classical order was: particles first, the second law later – being before becoming! It is possible that this is no longer so when we come to the level of elementary particles and that there we must *first* introduce the second law before being able to define the identities. Does this mean becoming before being? Certainly this would be a radical departure from the classical way of thought. But, after all, an elementary particle, contrary to its name, is not an object that is 'given'; we must construct it, and in this construction it is not unlikely that *becoming*, the participation of the particles in the evolution of the physical world, may play an essential role" (Prigogine).

Mermin, echoing Smolin and Rovelli, describes quantum states as "expressions of relations between subsystems". His IIQM (Ithaca Interpretation of QM) stresses "that measurement is nothing more than a particular kind of interaction between two particular types of subsystems, designed to yield a particular kind of correlation". "...The collapse, ..., is rather ethereal. ... These mixed states have evolved from the pre-measurement pure states in an entirely continuous fashion". "During the course of the measurement interaction the combined specimen-apparatus system evolves continuously from its uncorrelated initial state to the highly correlated final state". "It is a common error to view a mixed state as describing a system that is actually in one of a number of different possible pure states, with specific

probabilities. While this “ignorance interpretation” ... can indeed be a useful practical way to describe an ensemble of completely isolated systems, it entirely misses the deep and fundamental character of mixed states. ... This has nothing to do with our “ignorance”. It is a consequence of the existence of objective external correlation”. “Interactions with its environment have the precise effect of correlating a specimen with that environment”. “... a measurement of a specimen observable S is an interaction between the specimen and the apparatus designed to extend the Born probabilities from the specimen states $|s_i\rangle$ to corresponding apparatus states $|a_i\rangle$. This is a useful thing to do because although we humans are incapable of directly perceiving the conditions of a microscopic specimen, we are able to perceive the condition of a macroscopic apparatus.” “The quantum state of a complex system is nothing more than a concise encapsulation of the correlations among its subsystems”. Mermin is almost on the right track, except that, being an “orthodox” believer, he insists that his “IIQM correlations among the correlata of different subsystems have physical reality but the correlata themselves do not”. This begs the question then: “correlations between what?”.

We come finally to Leggett. His Leggett-Garg Inequalities (LGI) are the equivalent of John Bell’s inequalities, and equally momentous. What Bell inequalities attempt to show for space-like separated events correlation (Entanglement in Space), Leggett does for time-separated measurements (Entanglement in Time) – essentially a test of “classicality”. While Bell’s theorem, when tested, showed that no hidden-variable theory can be local (and hence established non-locality), Leggett’s theorem (temporal Bell inequalities) tries to show that no Realistic (Ontic) theory can be had – or as one commentator quipped: “No Moon there!”, in reference to Einstein’s assertion that “... the moon is there, even if I don’t look at it”. Many tests with photons, neutrinos, etc., starting with Palacios-Laloy and others, have verified Nature does not respect Leggett’s inequalities. Does this mean there is no reality?

Let us look where the devil is – in the details. Leggett-Garg violations actually mean one of two things: the absence of a realistic description of the system (Macroscopic Reality- MR), OR the impossibility of measuring the system without disturbing it (Non-Invasive Measurability – NIM), and they can only be tested together (since Realism by itself is consistent with the predictions of QM, witness

Bohm). The NIM postulate is hard to prove, with any experiment subject to the “Clumsiness Loophole”, where any number of possibilities exist for the measurement to impact the results. In addition, proper interpretation of the results is critical – “before-before” experiments (Suarez) conclude against macro-realism, but do not apply if a “single preferred frame” is assumed. Suarez discounts the preferred frame on other grounds (relativity), but our PL model already supports a preferred frame (via the superluminal PL ether, while still respecting Relativity). Ah... those details. One should be careful in coming to conclusions. Alain Aspect, who performed the first Bell-type experiment in the 1980s, in commenting on the mighty Zeilinger & Aspelmeyer’s Leggett tests, thinks the team’s philosophical conclusions are subjective. “There are other types of non-local models that are not addressed by either Leggett’s inequalities or the experiment”. Aspelmeyer, implying the QM dogma that reality does not exist when we’re not observing it, had suggested that “You would also have to give up certain intuitive features of realism”. Onofrio and Calarco argue against observability of LGI violations due to the uncertainty principle. Menicucci and Caves assert that “... NMR experiments up to about 12 qubits cannot violate any Bell inequality, temporal or otherwise”. Even Katiyar et al., using negative measurements to avoid the “clumsiness loophole”, agree that multiple other loopholes prevent the challenge to macrorealism. Emary et al. remind us that LGI violations “cannot strictly speaking be taken as evidence of quantum mechanics, but rather evidence of the absence of a description ...”. In a further hint, Kofler and Brukner demonstrated that “fuzzy” measurements on a quantum system explain the emergence of classical behavior.

In contemplating Leggett-Garg violations, Nicolas Gisin concluded that non-local correlations have their roots “outside” of spacetime, and that “the spacetime does not contain the whole physical reality”. Our PL world model, by distinguish a macro-generated spacetime picture from an underlying superluminal PL sheet infrastructure, provides that “outside”, in the form of the preferred Ether frame, with its patches of uncorrelated, isolated space.

Peres quips that Realism has “at least as many definitions as there are authors”. This discussion is not intended to add another definition, but to present a world view that allows many of the other definitions to cohabitate without conflict – by looking differently at spacetime, at patches in space, and the alignment of the micro-macro worlds, a new view arises.

“Quod non agit, non existit”. Translating Leibnitz, “Whatever does not act, does not exist”. For him, “Force” (read Energy/Action) was the ultimate

element of reality – “Ageres character substantiarum!” “To be real is to have causal power” (S. Alexander). Shakespeare posed it better, but “To be or not to be” is not the question; Getting Real is the key.

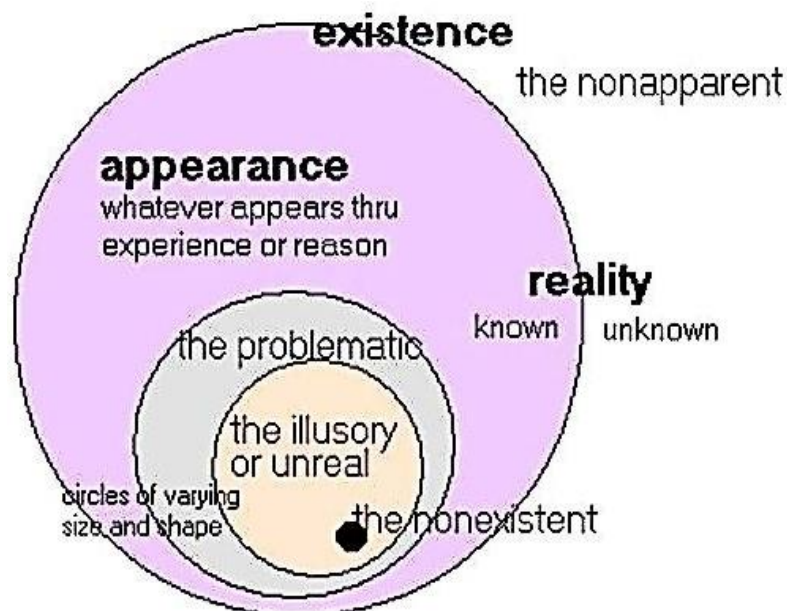
“The conception of objective reality of the elementary particles has thus evaporated not into the cloud of some obscure new reality concept but into the transparent clarity of a mathematics that represents no longer the behavior of particles but rather our knowledge of this behavior.” - Heisenberg

“Unperformed experiments have no results.” - Peres

“Nothing Happens until something moves.” - Einstein

“No elementary quantum phenomenon is a phenomenon until it is a recorded phenomenon.” - Wheeler

“The atoms or the particles are not real; they form a world of potentialities or possibilities rather than one of things and facts.” - Heisenberg



“Observations not only disturb what has to be measured, they produce it. In a measurement of position, the electron is forced to a decision. We compel it to assume a definite position; previously it was neither here or there, it had not yet made its decision for a definite position...” - Jordan

“The outcome of a measurement is brought into being by the act of measurement itself, a joint manifestation of the state of the probed system and the probing apparatus.

Precisely how the particular result of an individual measurement is obtained – Heisenberg’s transition from the possible to the actual – is inherently unknowable.” –

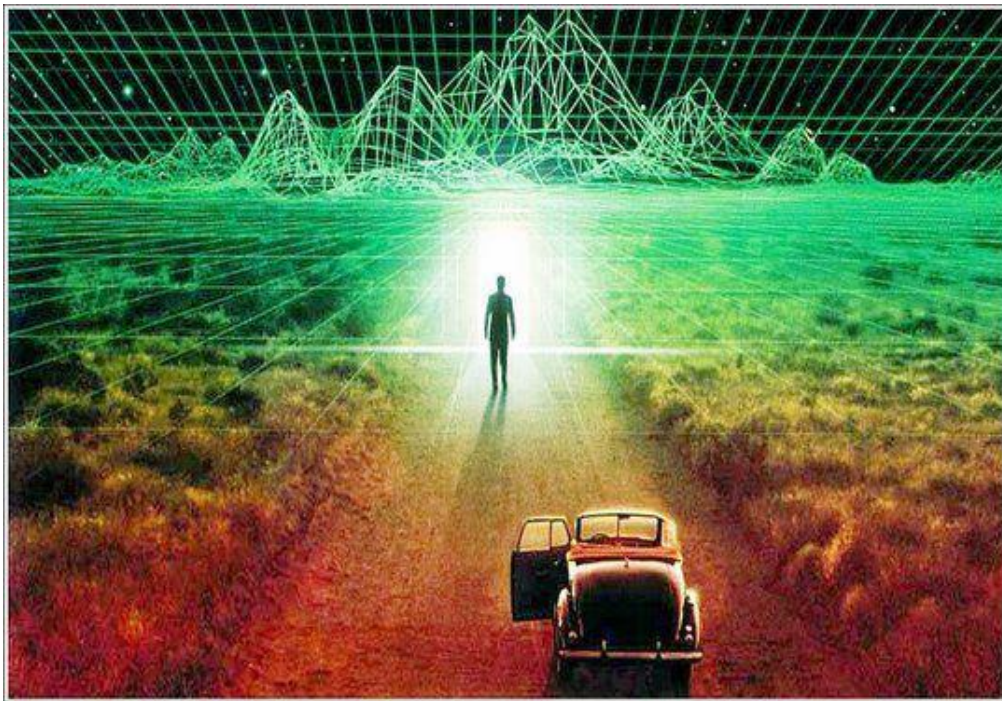
Mermin

"We cannot think of any object apart from the possibility of its connection with other things." – Wittgenstein

"... the Universe is constantly defining itself, and measurement is only a special case of this." - Hiley, Bohm.

Takeaway: Our world exists – always. However, it is only perceived (by us) through its relationships. Isolated particles, in their own patch of space, are therefore not “real”, not realized until they touch our macroworld. QM describes the probabilities of this interaction game.

"Everything we can observe is real, essentially by definition in common-sense language. Reality, in everyday language, is a macroscopic phenomenon". - Marburger



A Hidden Realization, As told by Gary Zukav

This is a beautiful story a Sioux friend told me. The Creator gathered all of creation and said, "I want to hide something from the humans until they are ready for it. It is the realization that they create their own reality." The eagle said, "Give it to me, I will take it to the moon." The Creator said, "No. One day they will go there and find it." The salmon said, "I will hide it on the bottom of the ocean." "No. They will go there too." "The buffalo said, "I will bury it on the great plains." The Creator said, "They will cut into the skin of the earth and find it even there." Then Grandmother Mole, who lives in the breast of Mother Earth, and who has no physical eyes but sees with spiritual eyes, said: "Put it inside them."

And the Creator said, "It is done."

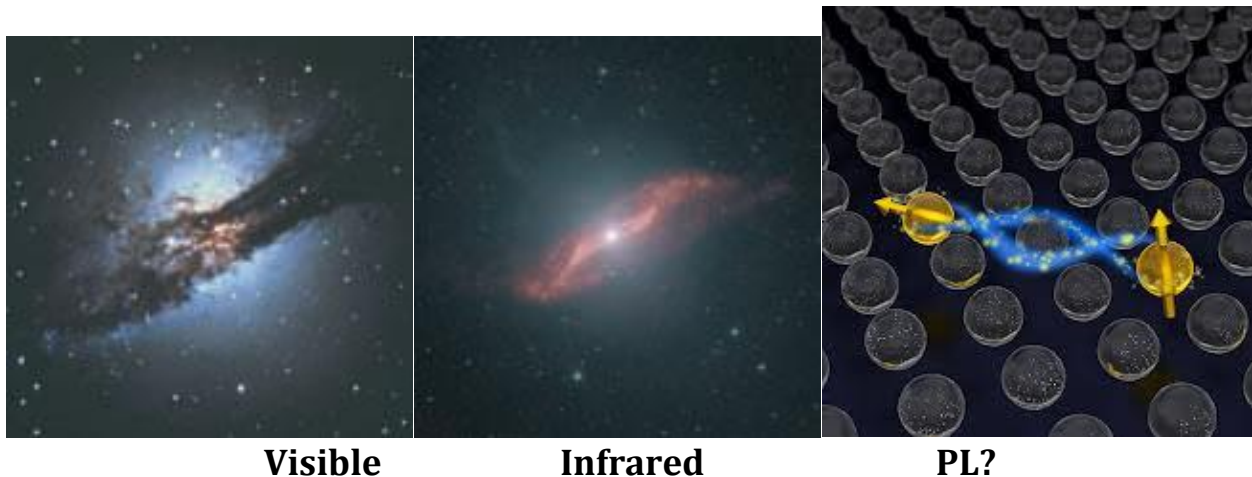
11.1 - REALITY

“Einstein’s “elements of reality” do not exist. No explanation of the beautiful dance among the three (entangled) particles can be given in terms of an objectively real world. The particles simply do not do what they do because of how they are; they do what they do because of quantum magic.”- Michael Horne

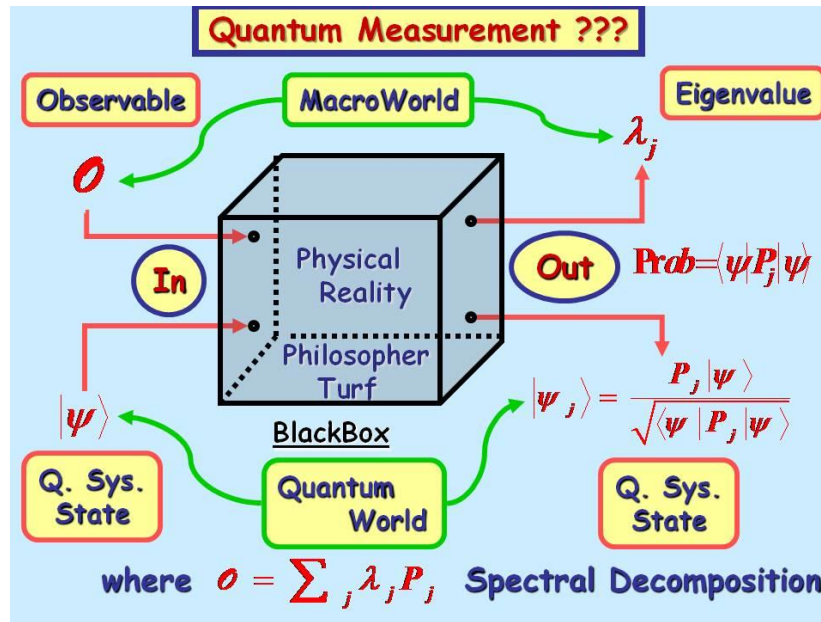
“Although the whole of this life were said to be nothing but a dream and the physical world nothing but a phantasm, I should call this dream or phantasm real enough if, using reason well, we were never deceived by it”. - Leibniz

According to Wheeler, the problem of the Quantum is the problem of being, of existence.

Bohr, Heisenberg, and the Philosopher Hoffding, discussing the Young double-slit experiment, wondered: Where did the particle go? Did it pass through one slit or the other? Bohr, always contemplative, muttered in his usual style: “To be... to be... what does it *mean* to be?”



What is Reality but what we see around us? We already discussed the fact that we cannot see “Now”, but what are those things we see anyhow? It turns out the “Instrument” you use is an important part of the answer. Our Eyes use the “visible” spectrum of light, a very narrow slice of the available electromagnetic range. The world looks very different in Night-Vision goggles. The dark night sky will blaze in colors to an X-ray telescope or Gamma Ray detector. The instruments present different views, which if we had in our natural mind, would seriously alter our view of the world around us. A Microscope (optical or electron) shows an incredible world where we may have seen gray matter or a flat surface. So what would a “PL” Microscope show us?



- Since the “matter” we speak of is oscillatory in nature, being a duality between existence and non-existence, its manifestations are hence transient, illusory impressions. Bohr may have been right about resisting a description of nature, insisting on its “observables” only. If it is claimed that an element had, has, and will have no influence on anything we can possibly observe, then by definition that element does not exist (for us at least).
- “Isolated” systems would have no time, no location- both being relational elements of their interaction with other systems. Position is a relative measure of “spatial” order, and “order” is a measure of relations. No relations, no order, no position. Similarly Time (and hence speed and momentum) is a measure of causal order, and “causal” assumes interactions. No Interactions, no order, no time.
- Causality would be a consequence of the ordering effect of such interactions, their impact providing a “relative time”, defining “later time” by default.
- Universal time would then be illusory, a tapestry of causally ordered “local” interactions and timed events. “Local” being a projected state, since it is defined by its relationship to other events, which, Hologram like, could be driven from a collocated source (and thus entangled). This Time, defined as the true order of events, has by definition a forward Arrow, enforced by causality. Good bye Time Travel. (Greenberger & Svozil proved that the hard way as well – “looking backwards, the world

is deterministic. However, looking forwards, the future is probabilistic”).

- “Measurement”, being an interaction, forces independent isolated local events (a passing photon, for example) to causally synch up with other local relations, and “realizing” itself to us. The “reduction” of the wave packet by measurement, according to Blokhintsev, simply means that a particle belongs to a new “ensemble” after a measurement, its correlation with this new ensemble assuring its reality. Wheeler aptly put it: “No elementary phenomenon is a phenomenon until it is a registered (observed) phenomenon.”
- The world is constantly being “realized” by the phenomenon of “decoherence”, whether via GRW (Girard, Rimini & Weber), Penrose’s Gravity, or interactions with macro effects. Continuous “measurements” continuously collapse the wave function, realizing the particles involved, without the need for observers to collapse it – Nature is its own watchdog, not waiting for us to verify it. When we come to observe it, it is already there for us to see.
- Penrose’s Gravity approach is amenable to our PL view: the objective wave reduction, or collapse, takes place due to the different space-time geometries of each state in the “superposition”. The various superpositions affect the curvature of space time differently, eventually reaching a critical level when “entangled” with the environment, and the superposition collapses to one of the possible states. In our PL view, the “isolated” particle is “nowhere”, and therefore in many positions and orientations, until it has something to relate to.
- Decoherence has been confirmed experimentally – Haroche’s experiments in Paris (1996), entangling a few photons with an atom, and watching the superpositions decohere.
- Heisenberg summarized the Copenhagen view: “We see from this that a system cut off from the external world is potential but not actual in character, or, as Bohr has often expressed it, that the system cannot be described in terms of classical concepts. We may say that the state of the closed system represented by the Hilbert vector is indeed objective, but not real, and that the classical idea of “objective real things” must be here, to this extent, abandoned... The description of a fact can be effected in terms of classical concepts in just the approximation in which classical physics can be used. The mathematics of quantum

theory can be used for this description as well, i.e. the boundary between the object in quantum theory and the observer who describes or measures in time and space can be pushed further and further in the direction of the observer... Knowledge of the “actual” is thus, from the point of view of quantum theory, by its nature always incomplete knowledge. For the same reason, the statistical nature of the laws of microscopic physics cannot be avoided.” However, as Shimony says, “the actualization of potentiality must not be conceived as a limiting case of probability – as probability 1 or 0. Instead, actuality and potentiality are radically different modalities of reality”.

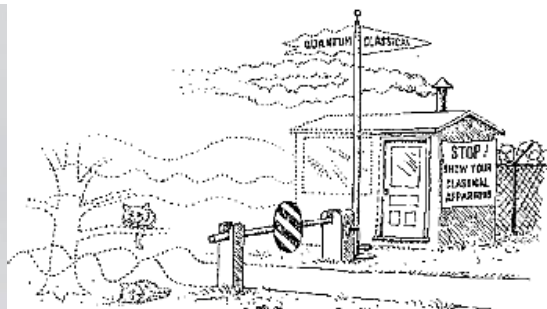
- Marburger: “The wave function specifically links “something microscopic out there” to the macroscopic objects of our human-scale reality”. “It is out of them in the untold aggregate that we build our spatial and temporal concepts” (Hoffman). “These electrons and the other fundamental particles, they do not exist in space and time. It is space and time that exist because of them. These particles-wavicles... precede and transcend the concepts of space and time. ...space and time are not the fundamental stuff of the universe but merely particular average, statistical effects of crowds of more fundamental entities lying deep down”, just as “ordinary temperature and pressure are crowd effects. When we try to examine them too closely, by observing an individual molecule, they simply vanish away”. “The message of the quantum suddenly becomes clear: space and time are not fundamental”. An individual particle is not in two places at once. It is no place at all. ... The quantum paradoxes are of our own making, for we have tried to follow the motions of individual particles through space and time, while all along these individual particles have no existence in space and time”.
- Wheeler had a funny analogy of our view of reality. His three Umpires would say:
 - I calls ‘em like I see ‘em (traditional science)
 - I calls ‘em the way they **are** (Einstein)
 - They ain’t **nothing** till I calls ‘em (Bohr)
- Einstein, perhaps unwittingly, provided a compromise understanding in his article “Maxwell’s Influence on the Development of the conception of Physical Reality.” “...since our sense-perceptions inform us only indirectly of this external world, or Physical Reality, it is only by speculation that it can become comprehensible to us. From this it

follows that our conceptions of Physical Reality can never be definitive; we must always be ready to alter them, to alter, that is, the axiomatic basis of physics, in order to take into account of the facts of perception with the greatest logical completeness.”

"Nothing ever becomes Real till it is experienced." - John Keats

"So farewell, elements of Reality!" - David Mermin

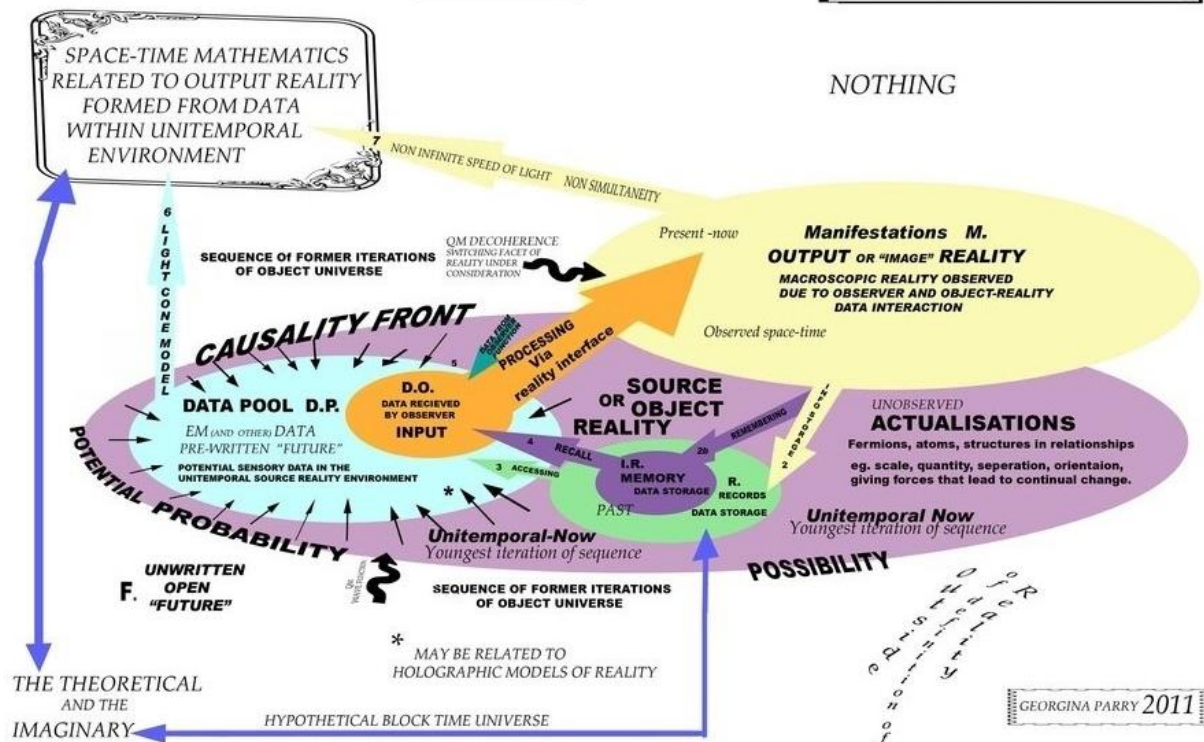
“Two things I cling to: a belief in external reality, and radical skepticism about all theories of it”. – E. Nelson



The border between quantum
and classical.

REALITY IN THE CONTEXT OF PHYSICS

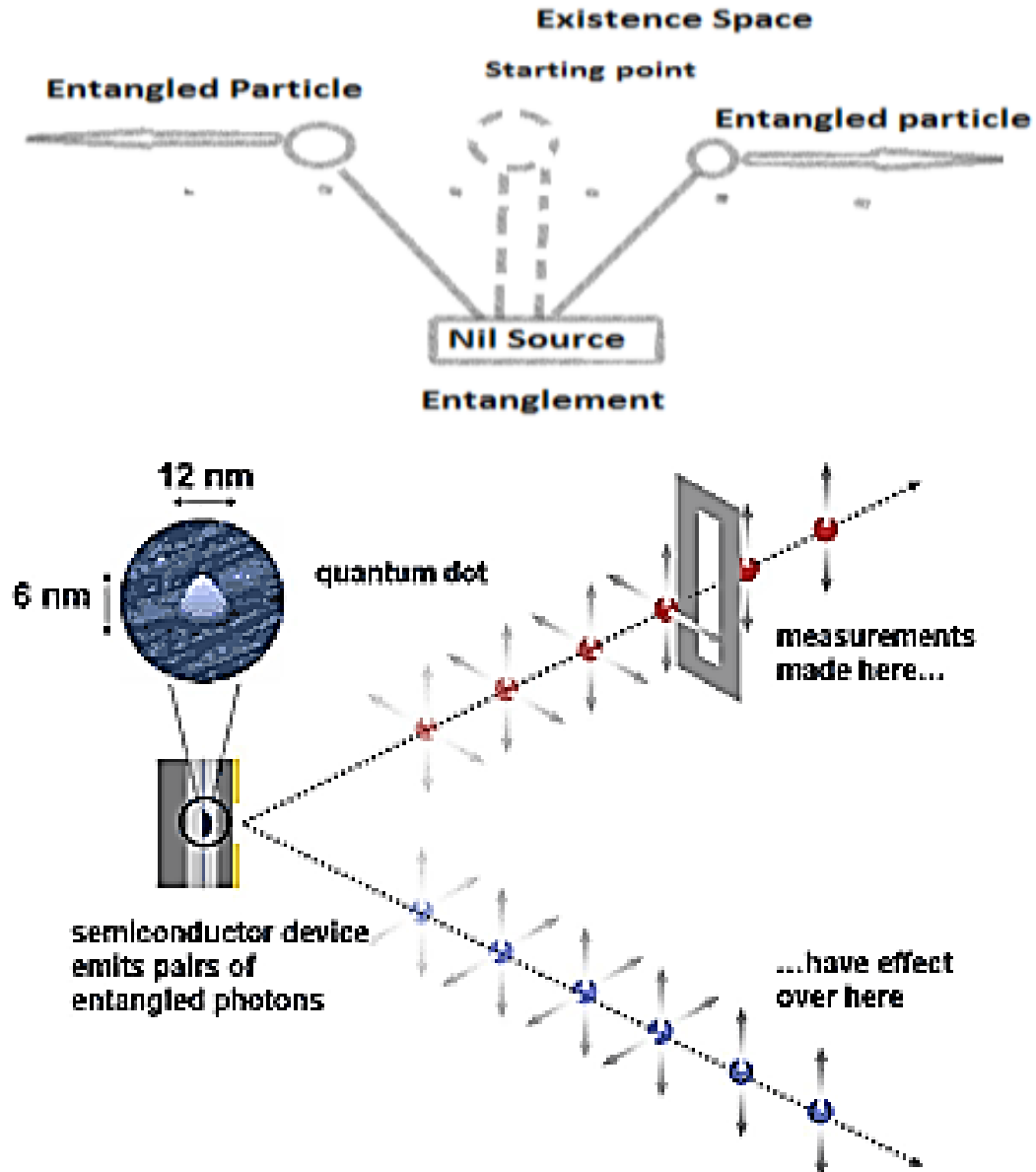
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11.2 - ENTANGLEMENT & NON-LOCALITY

“Entanglement is not one but rather the characteristic trait of quantum mechanics.”
– Erwin Schroedinger

The Stoics thought the world had an “inner connection”, a tension (tonos), whereby distant parts of the Universe influence each other. Today we call it Entanglement.



Erwin Schroedinger himself coined the term. “If two separated bodies, each by itself known maximally, enter a situation in which they influence each other, and separate again, then there occurs regularly that which I have just called

entanglement of our knowledge of the two bodies.” He of the famous cat, who did not like the effect, still recognized its inevitability.

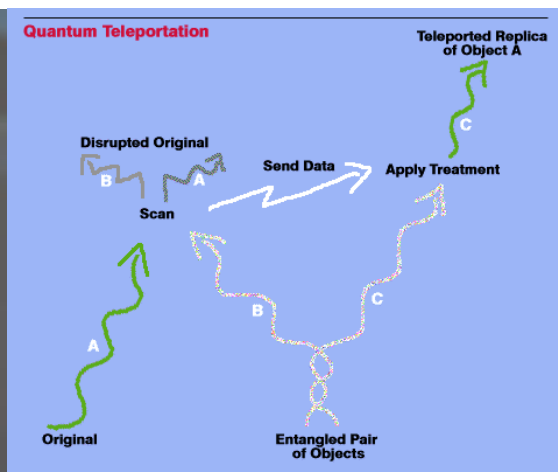
Through the magic of entanglement (“Passion at a distance”, says Abner Shimony), the particles respond instantaneously across any distance separating them in order to give us the results that quantum theory says will be obtained. Quantum theory is correct, and Einstein’s local reality is wrong. Shimony, with his student Myrvold, confirmed that no algorithm can mathematically “prove” two particle states are entangled, but like many of the mysteries of physics, you know it when you see it.

This amazing ability to correlate actions at huge distances is one of the unresolved mysteries of Quantum Mechanics, and a sore point for Einstein & Bohr. The PL picture simplifies the problem a bit:

- The Huge distance is really not huge at all, since it is only our perception of the causal spread of the macro PLC motions that gives that impression, space being the “ordered relationship” in perception.
- The PL is blinking in and out of existence, in Nodes of “Virtual space”, a hyper-construct that appears as real space to us. The distances we see are distances in that Hilbert space.
- But in that blinking, the PL returns to its oblivion, non-existence, the “Nil-Source”, **itself a Hilbert Space**, tightly bound.
- Starting in an inter-related state (Entangled), creates an entangled affinity in the Nil-Source, which can direct impacts and changes in one existence plane node to other nodes, regardless of their “distance” in the Existence Hilbert space.
- So Space is not always local- partly because it is an ordered construct and not primeval, and because the Nil-Source acts as the conduit for entanglement during E/N Transitions.
- The Universe thus described is a large entangled set of fermions, anti-fermions (conjugates/reverse of fermions), bosons (combos of both), their “wavefunctions” combined in the Nil-Source.
- Feynman, in his Nobel Lecture, says: “The behavior of Nature is determined by saying her whole space-time has a certain character.” And that “We have, instead, a thing that describes the character of the path throughout all of space and time.”



Anton Zeilinger

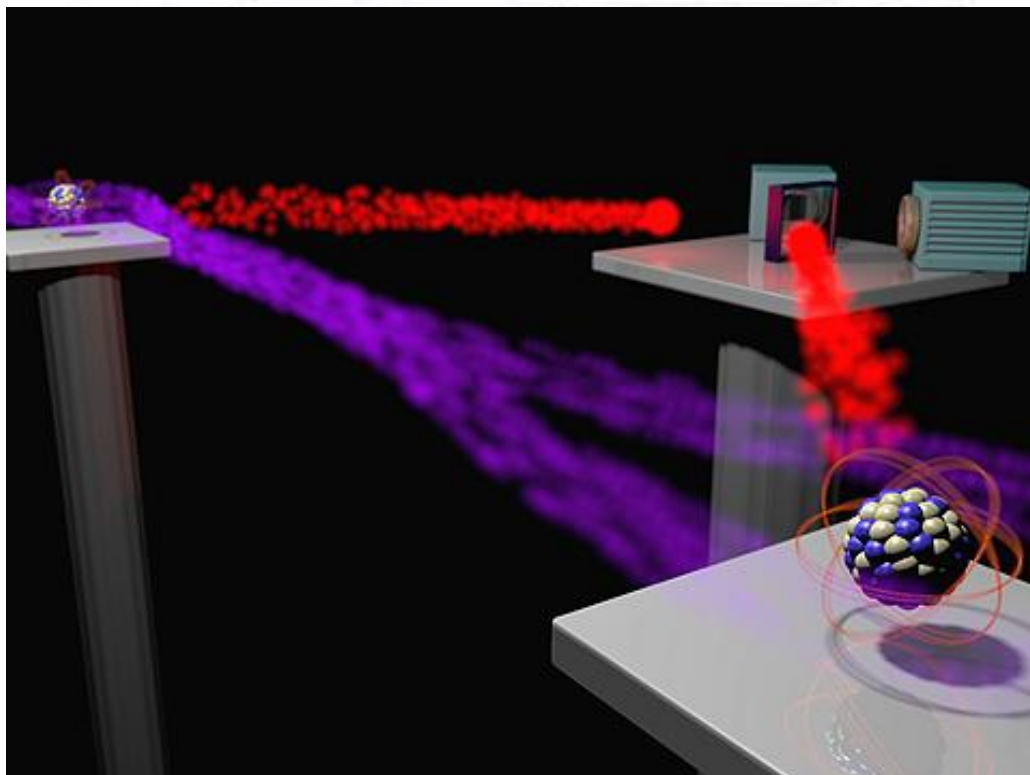
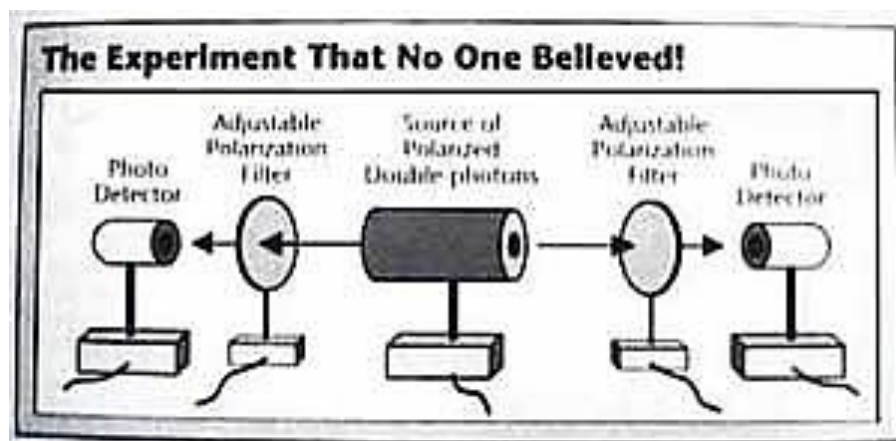


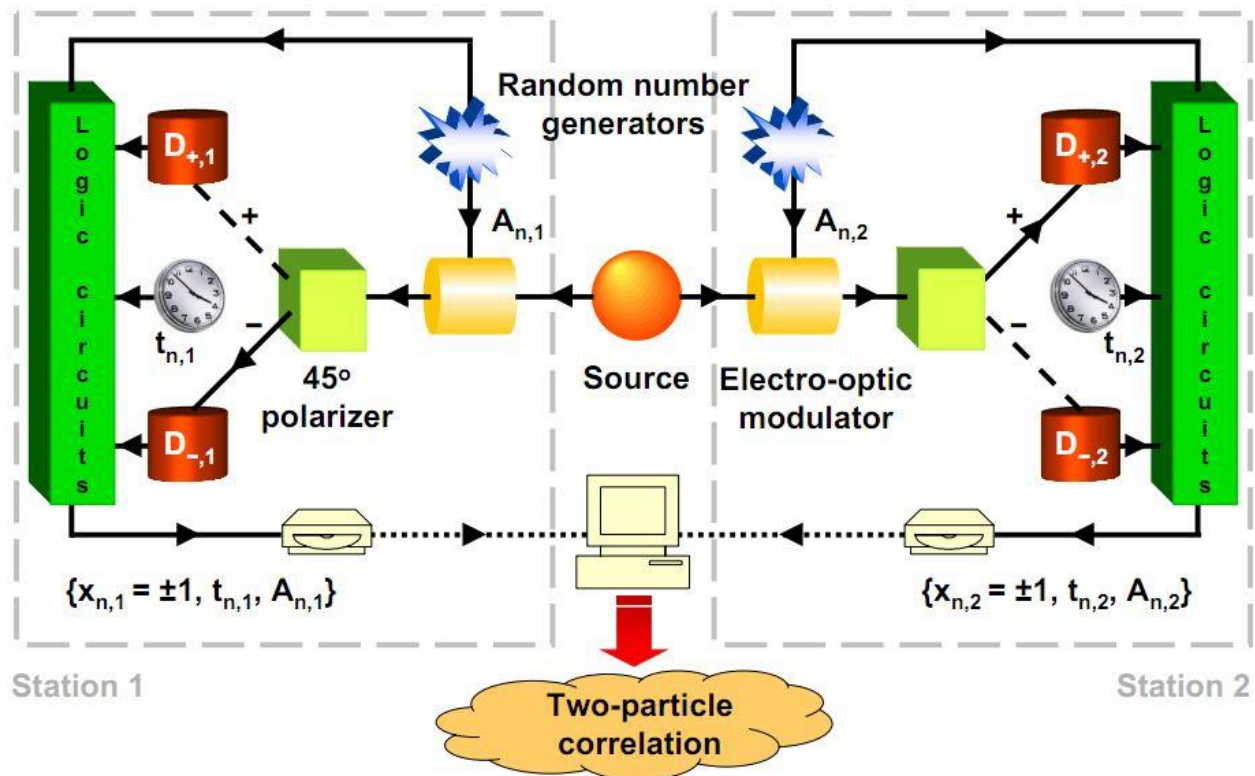
Quantum Teleportation

This phenomenon, challenged by Einstein in the EPR paper, clarified and put on a theoretical, measurable basis by John Bell, was verified by experiment repeatedly, first by Shimony et al, then most convincingly by Alain Aspect, and more recently by the magical experimental skills of Anton Zeilinger & the GHZ team (who clarified three particle entanglement, improved Bell's approach, and demonstrated quantum Teleportation). Even discounting Bohr's muddled response to EPR ("I have very little idea what this means", quipped John Bell), The Universe is NOT local. Quantum theory is correct, and entanglement is here to stay. Incidentally, much of the work on this phenomenon was clarified by folks at Rochester University, where I *should have* gone (on a fusion research scholarship), by the likes of Leonard Mandel, Emil Wolf, and Nicholas Pisin. (I later came to work in Holmdel, NJ, where the CBR was discovered- always close, but yet so far from the boundaries of knowledge I long for.)

The PLs themselves do not "see" the "distance" in the "Real" world. They can pop out anywhere, based on their Netherworld correlations. The "Speed Limit" of Light only applies to Radiation, those "Rolling Waves" of PLs, restricted in their configurations and driven by a "Pressure" of their intensity and formation, and an apparent restriction in their flow. This Special Feature of the Light, the correlated PLC, is "our" speed limit, since we are made of clusters of it, and since we "see" the world through it. Sorli goes one further: *"Time is a numerical order of a duration of a given physical phenomena which runs in a 3D quantum vacuum. At the Planck scale there is no time, physical phenomena are immediate". "The immediate phenomena (such) as EPR, gravity information and energy transfer are carried directly by the fundamental grains of a 3D quantum vacuum. ... "Relativity" starts at the scale of the pi meson."*

So imagine our world as a “pop-up” version of a hidden realm, where the PLs that create our space and matter are reflections of an equivalent negation. The images and distances and actions we see in our world are orchestrations of those logical points, not really happening in any space or time, since those are emanent constructs. Meanwhile, in the hidden realm, those same correlations are duplicated, but linked tightly at their source – space and time for them is not emanent – that being largely a human construct. When seen in this light, action at a distance and instantaneous effects are no longer surprising, simply because distance and time are irrelevant. We solve the problem by rejecting its premise.



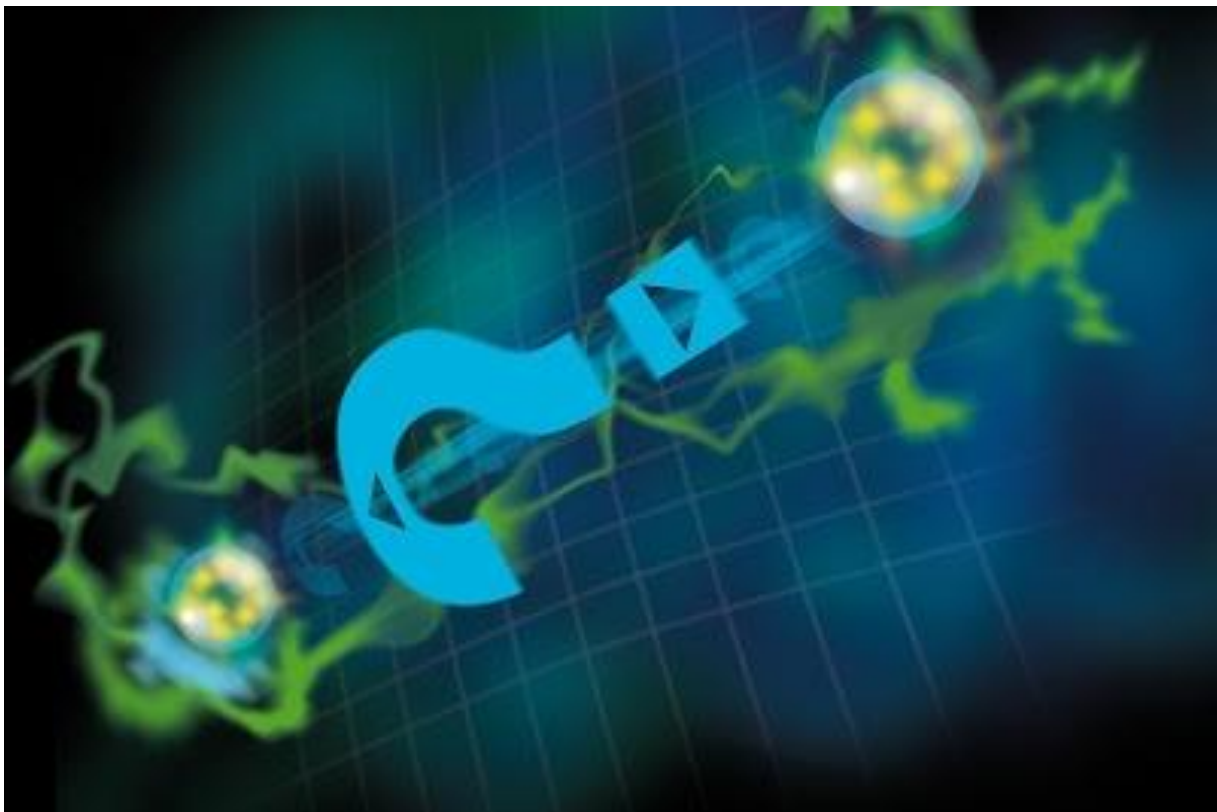


A different way of looking at this is as follows: Our emanent reality is causal and obeys relativity's speed limit BECAUSE it deals with PLCs – energy & “matter”, that INTERACT. Those interacting entities are discrete nuggets, and their “motions” require a coordinated dance, necessarily continuous in the Hilbert Space. On the other hand, the “fabric” of the Universe, the so-called Vacuum (alternatively “Dark-Energy”), is widespread, already continuous and uniform (hence undetectable), formed by individual PLs, who DO NOT have to obey continuous motion rules between nodes. The “Speed Limit” of relativity therefore only applies to those nuggets – you cannot transfer energy or “information” faster than the speed of light. But nothing stops the PLs from going “faster than Light”, although we can never see or measure this, PLs being the basic lowest level component of existence. Hence the “instantaneous” transfer of entanglement is not an issue for PLs, as long as the PLCs themselves do not jump discontinuously. The “Observables” of our Universe (PLCs) are speed limited, but the “Vacuum – PL Fabric” PLs are not.

Einstein's relativity, which deals with emergent space and time only, does not need a vacuum, and hence results in the speed limit effects and has trouble accommodating QM instantaneous and entangled effects. Extending the concept to a “Filled-Vacuum” concept where a PL sea forms space, gravitation,

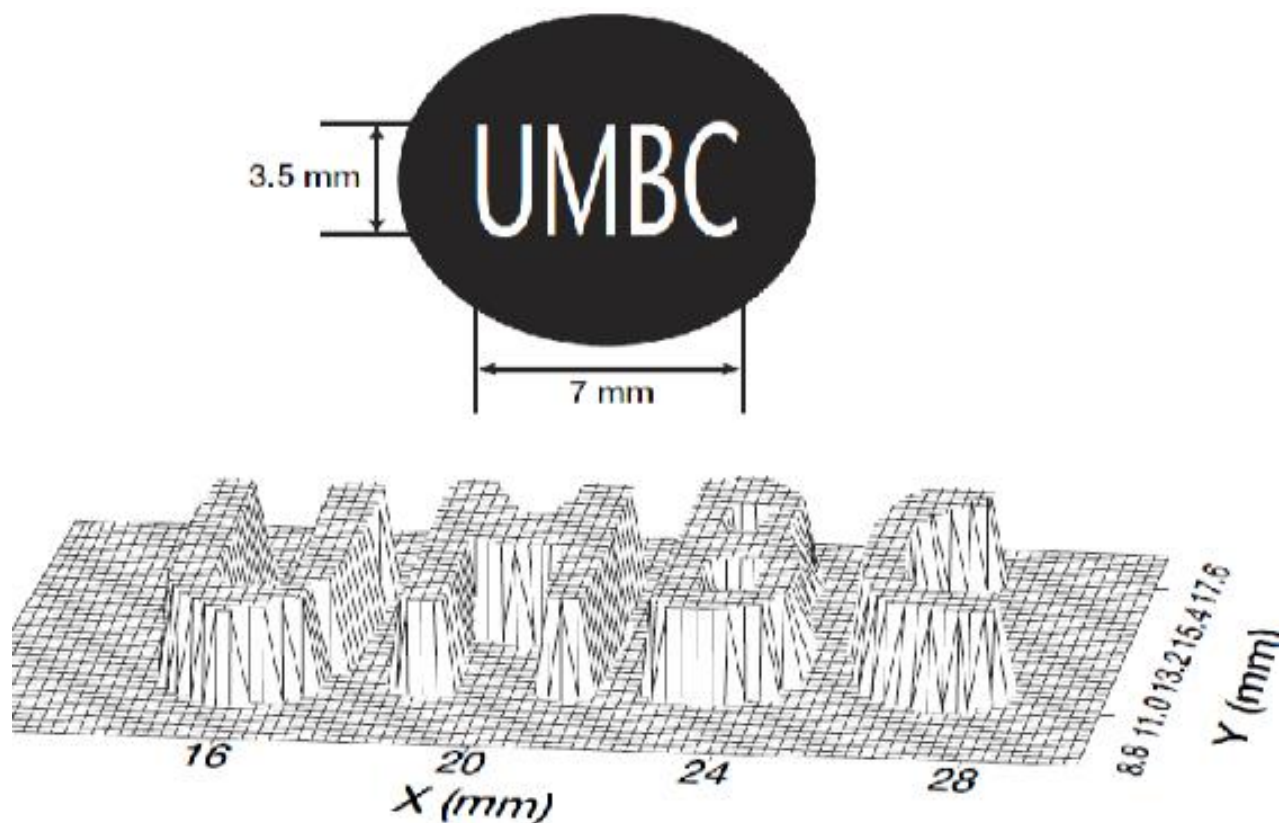
and the “rest of the Universe” that can move “instantly” and carry “correlations” enables an explanation of those effects.

Classical time, observable time, results from the causality of the interactions of the “observable” PLCs. That is why “Time” is not reversible, and why the Thermodynamic “Arrow of Time” points in only one direction. It is what Newton saw as “Absolute Time”. For the individual PLCs of “Space”, where no interactions or causality is produced, no such “Time” emerges, and hence speed, simultaneity, relativity do not apply. This is the carrier of “Non- Locality” and entanglement – the carrier of the Pilot waves and the metric field.



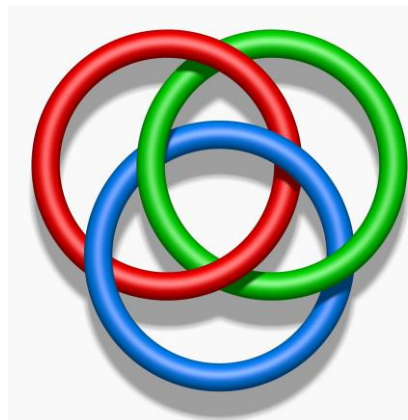
Quantum Erasers, Ghost image experiments, and others enforce the idea that the entangled particles are “One entity”. Experiments have verified this entanglement for two and three particles. Since they are clearly separated in our visual world both by distance and time (delayed effect experiments), then their one-ness is demonstrated somewhere else – in the hidden realm, the Netherworld. In that world, our “separateness” of distance and time is irrelevant, and what counts is the correlation, the joint algorithm of the particle’s configuration in Hilbert Space. That Algorithm even senses the

possibility of measurement, enough to change the outcome of experiments from a wave-pattern to particle-like behavior.



Ghost Image Experiment

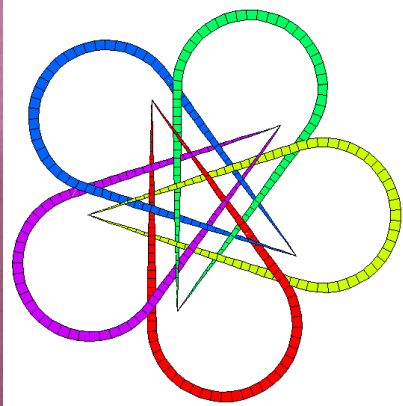
A related mystery of non-local effects is the Aharonov-Bohm effect. Areas where the electromagnetic field is ZERO (which you would understand as non-existent), can still affect electrons at that spot. The PL Pilots, present but not measurable at that point, still perform their correlative effect.



Borromean Rings



Hopf Rings

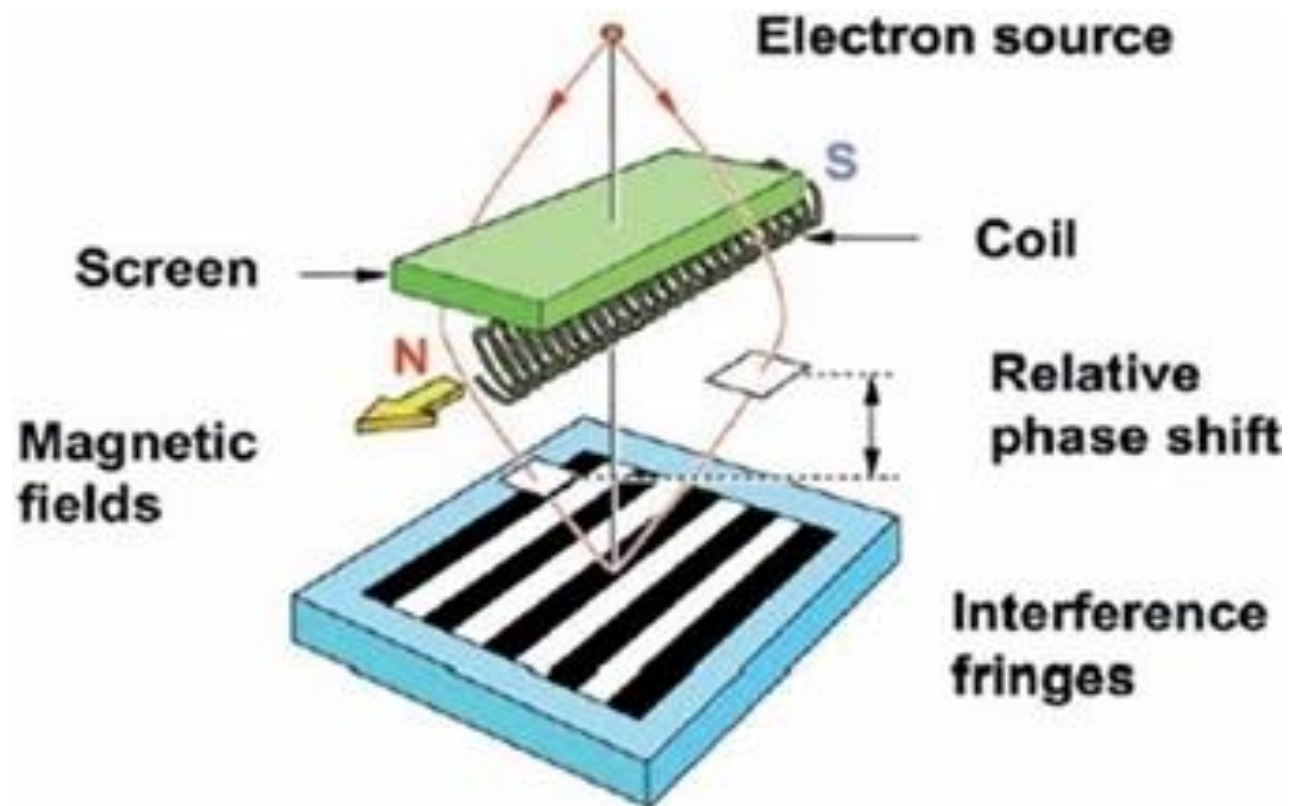


Knots

A clue to how this entanglement could be effected in the Nether realm is again given by Geometry, and the theory of Knots. As P.K. Aravind demonstrated, a deep correlation exists between entangled states in quantum mechanics and topological knots. Borromean Rings, Hopf Rings, and other generalized ring topologies can simulate the effects of multi-particle entanglement.

In this approach, each particle is seen as a ring. Measuring the ring of a particle is equivalent to cutting the corresponding ring, with the entanglement being the inability to separate the corresponding rings. The result faithfully models the GHZ entanglement of three particles.

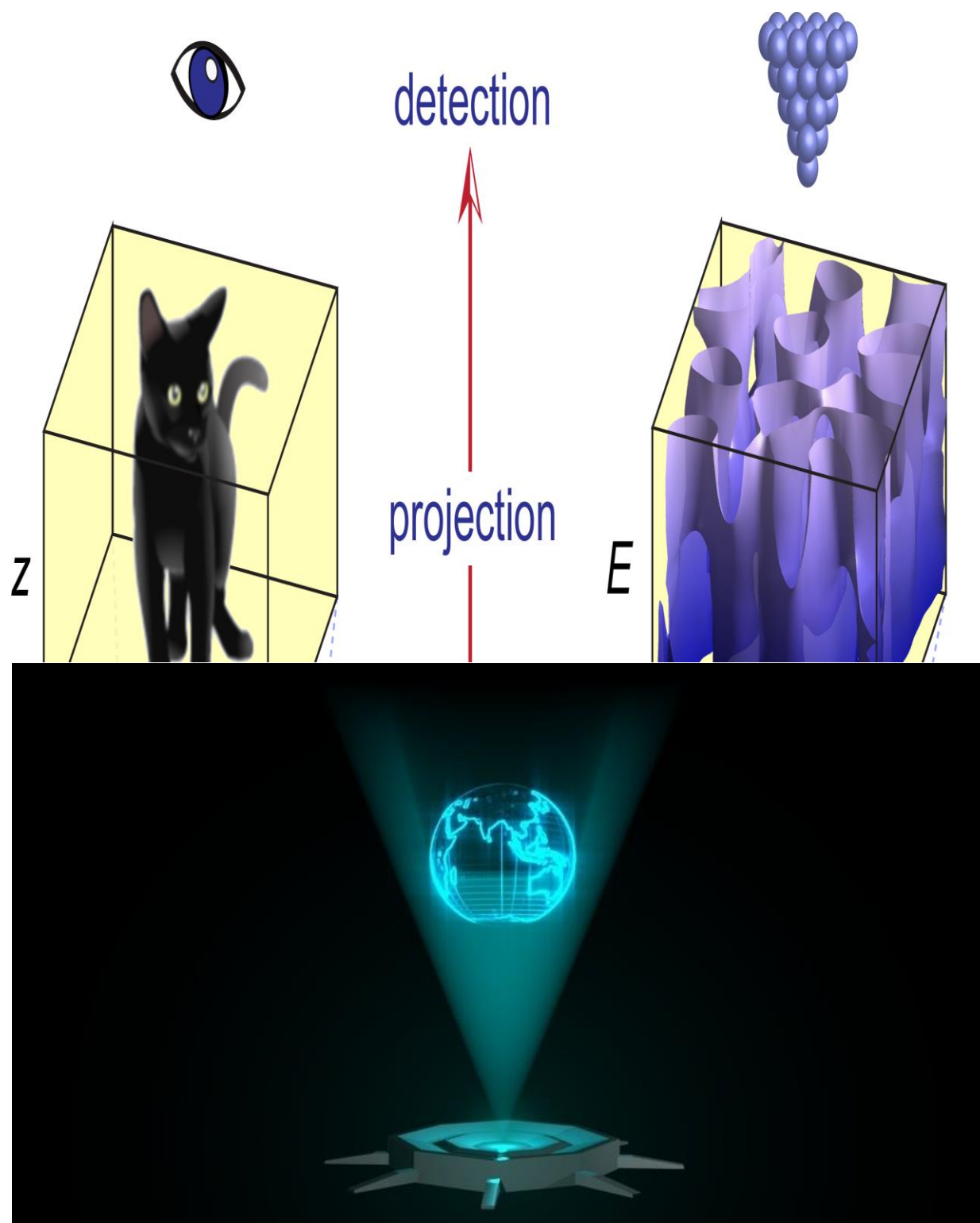
We go full circle again. Correlation is a geometric effect, but in the Netherworld, where entanglement lives. Locality is an approximate notion, when there is an approximate notion of spacetime emergent.

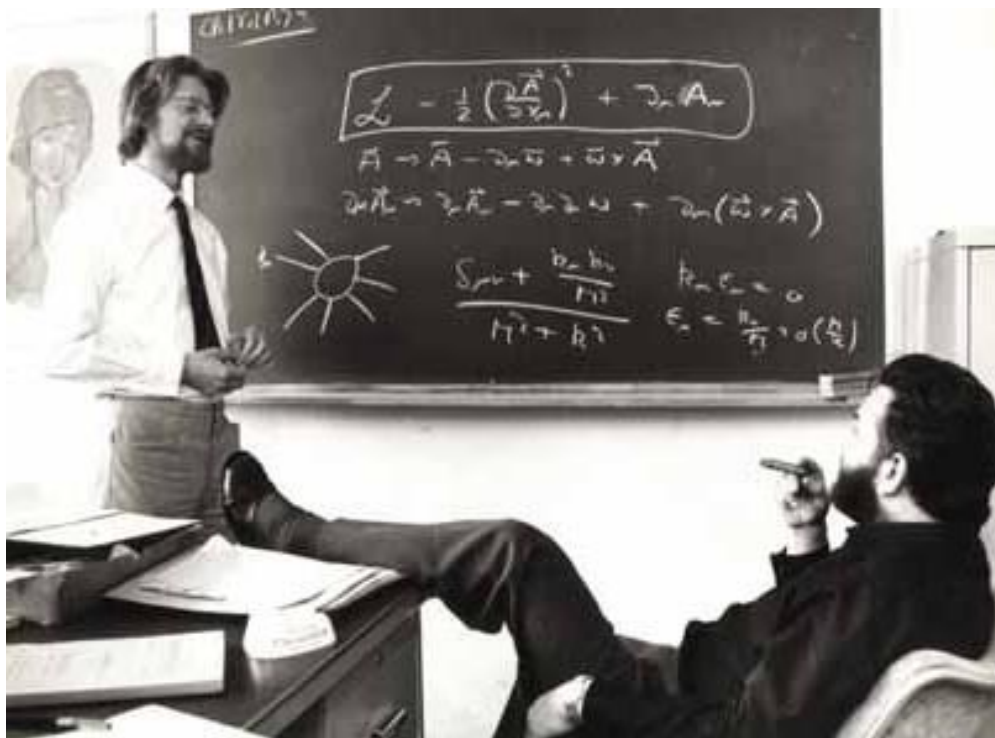


Aharonov-Bohm effect

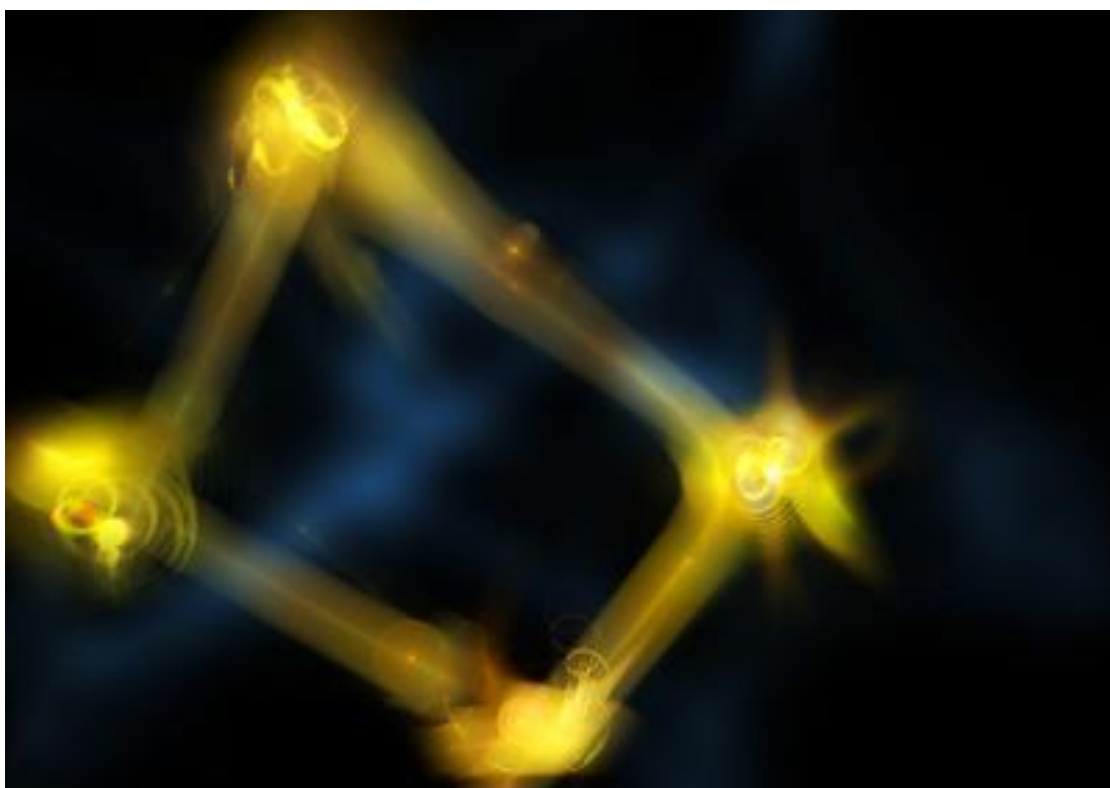
The Nether world is a static plane, where the “particle’s” image or wavefunction lives. The real world is a projection of that image, that moves in its own Hilbert space. Picture a Holograph, where the “disk” is the

Netherworld, and we are the image. The static disk keeps the correlations of particles as they move, and provides the entanglement we see.



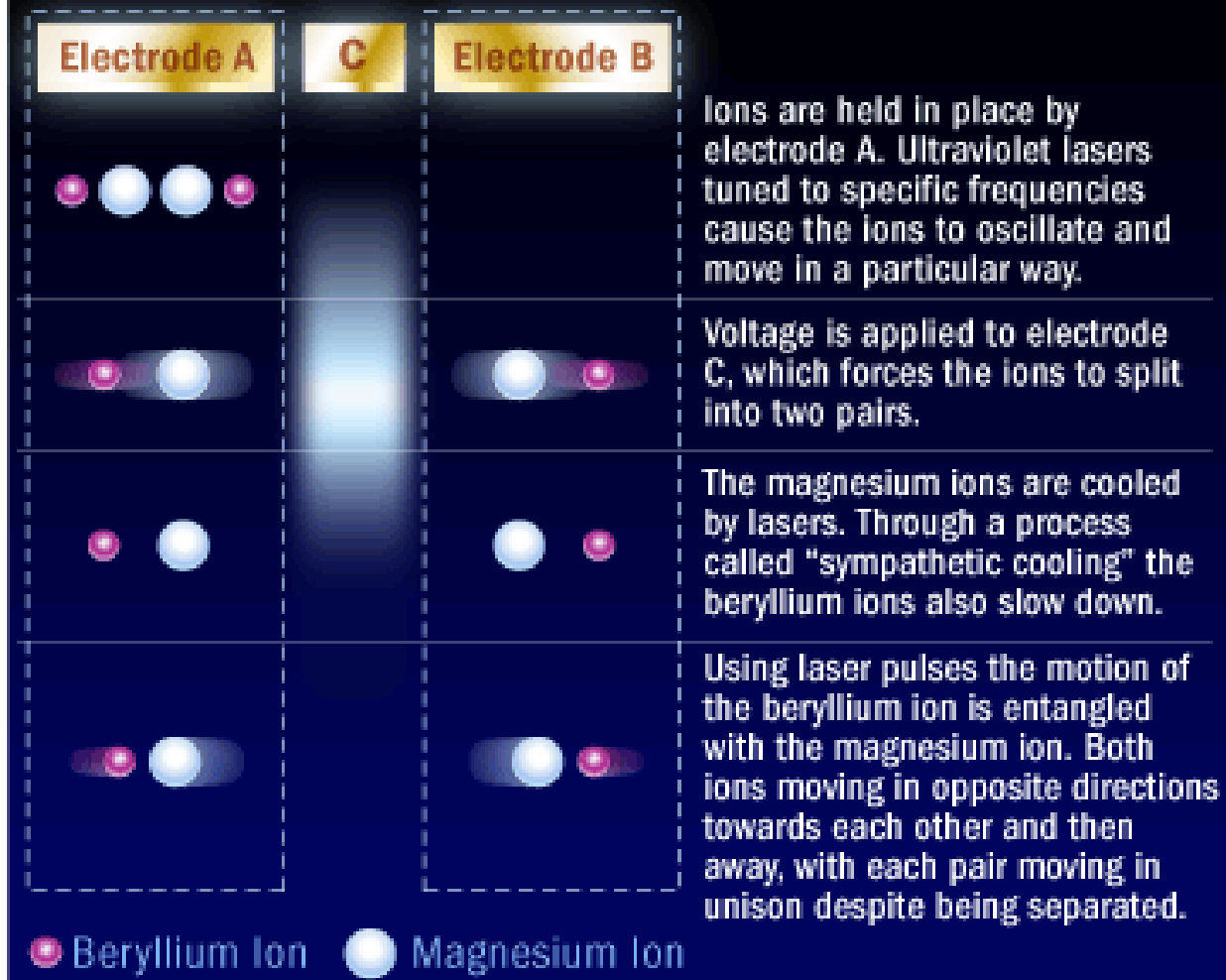


"It may be that a real synthesis of quantum and relativity theories requires not just technical developments but radical conceptual renewal."
- John S. Bell



NIST Entanglement Experiment

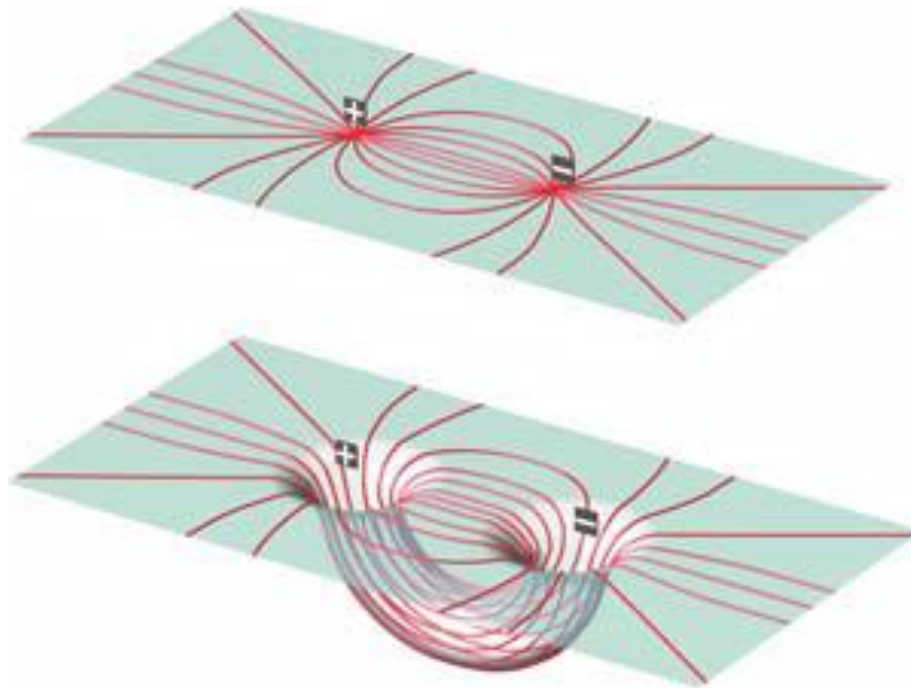
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Another group in China entangled five photons, by sending them through beam splitters. How does our PL picture see this? An isolated photon is in its own space time, out of touch with the rest of reality, a cluster of PLs in an island in the Hilbert Space. When it interacts with another photon, they create a new, joint "world" of their own, a space-patch swimming in the larger Hilbert space of nodes, but uncorrelated to it. These two photons we call "entangled", since by their relationship they define an **alignment in space-time** of their characteristics. Until they meet another component of that larger Hilbert world (and hence de-cohere, and lose their entangled state, by aligning with the new world they meet). Being is relationship, and the entangled photons relate to each other, aligning with each other, **defining an isolated island in the mesh**. What is entangled is the photon's space mesh! When the

external world intervenes, they now have to align with it, and lose their entanglement and are instead entangled with the larger macro world.

What looks like a “physical connection” between the particles is a meshing of the observer’s (not necessarily a person) knowledge about the two particles. A Physical connection would allow faster than light signaling, which we do not have. The collapse of one particle’s “wavefunction” is really a collapse of our uncertainty about that particle, and with that, a-la Bertlmann’s socks, comes the collapse of our uncertainty about the “entangled” particle.

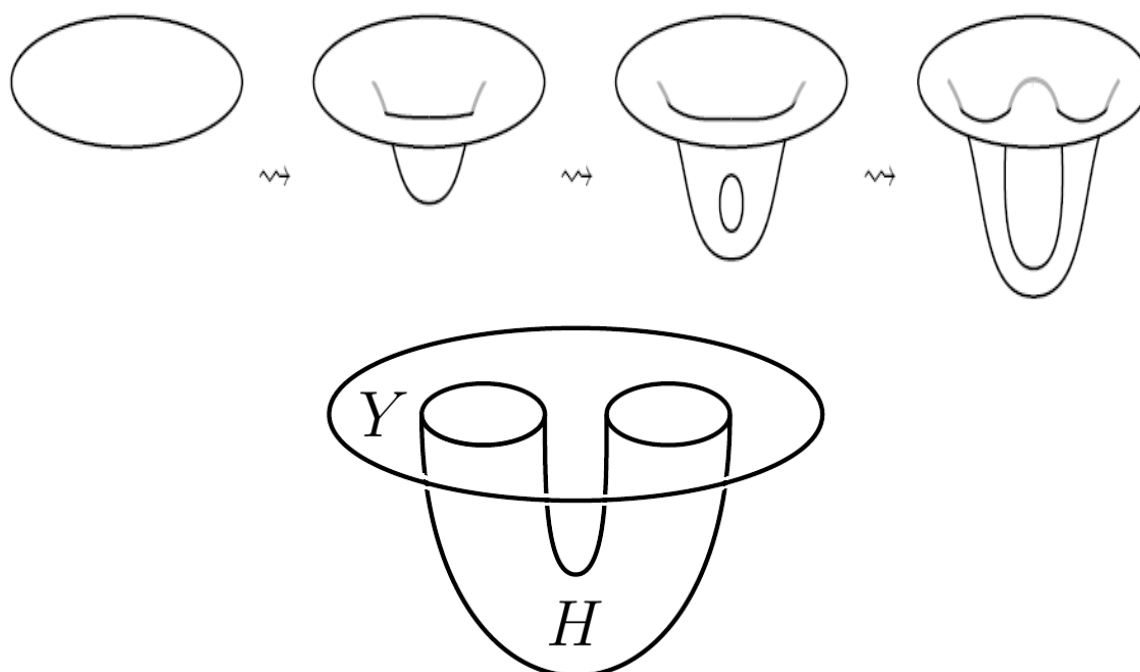


The “isolated” space-time mesh connecting the two entangled particles can be visualized as a “wormhole” outside the normal space-time mesh. This idea has been explored extensively to picture particle-antiparticle pair creation as a sort of wormhole creation in the space-time fabric. The same concept was applied to understanding the electric fields of charged particles as coming out of a particle, flowing into a wormhole, and coming back from the other end. This would make Maxwell’s equations Einstein’s Field equations, with mass = charge, and Newton’s Gravitational Constant= Coulomb’s constant, and vice-versa. John Wheeler calls this “Charge without Charge”, an Einstein-Rosen bridge for a micro-blackhole (particle), giving the illusion of the EM field flow. Einstein had originally proposed this as a way of representing an electron as a black hole, using General Relativity to explain the mysteries of the quantum

world (where matter is viewed as a distortion in the fabric of space-time, and subatomic particles are actually kinks or wormholes in curved space that looked like particles, with the electron being a disguised mini-black hole). The entanglement of the “state” of the pair of particle is “riding” on the entanglement of the “space” of those two particles. The “entangled” space is really just one island mesh, entangled with itself, with the “particles” (kinks in that mesh) along for the ride.

Another clue that QM is a space-time phenomena, like all else. Uncertainty and entanglement both come from the way “chunks of space” are glued together and aligned, with Topological Quantum Field Theory (TQFT) and category theory showing the way. Those Hilbert Spaces of “Skins of Observation” (Louis Crane) indicate “States become correlated only locally, i.e. only on skins. Somehow, the classical equation of motion must emerge in a situation where many bodies measure one another’s state very often”.

This view of entanglement as a “wormhole” is supported by no less than Juan Maldacena and Leonard Susskind (originally in relation to black holes). “We note that blackhole pair creation in a magnetic field “naturally” produces a pair of blackholes in this state. It is very tempting to think that any EPR correlated system is connected by some sort of ER bridge ... we speculate that even the simple singlet state of two spins is connected by a (very quantum) bridge of this type”.

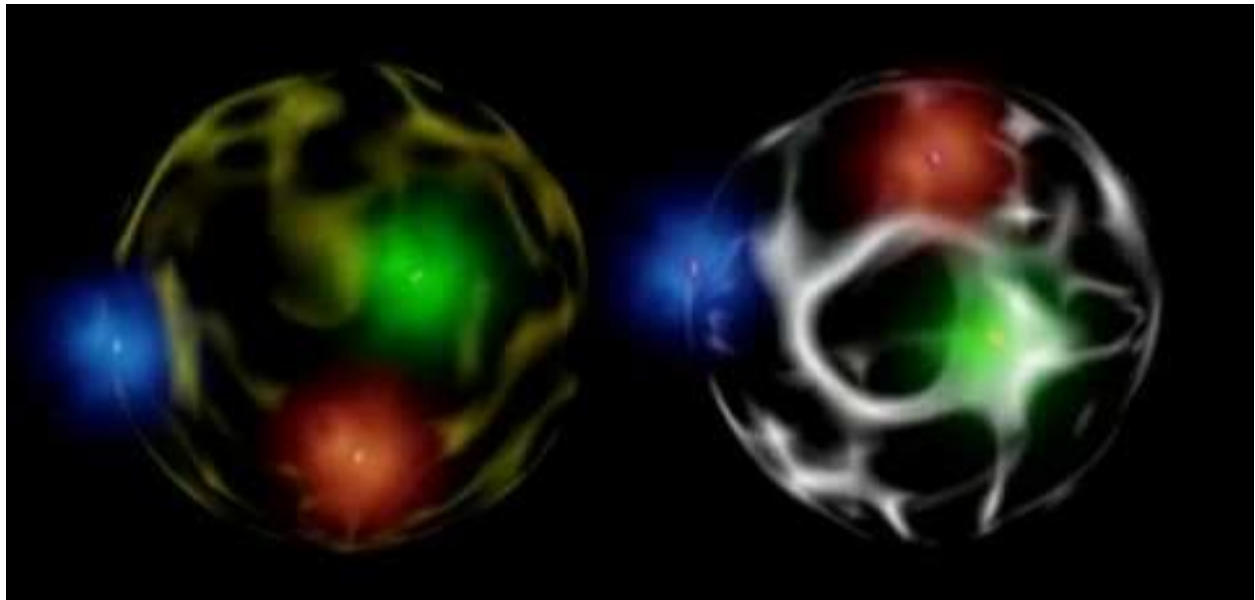


Wheeler had also proposed that electrons can be seen as lines of electrical force trapped in the topology of spacetime (Misner, Wheeler and Thorne, 1973), with the electron a vortex or wormhole in space, stable and quantized. Abdus Salam, in reviewing QED's renormalization techniques, points out that looking at the electron as a mini-blackhole, if gravity is not ignored, then the theory "has an inbuilt *cutoff at the Schwarzschild radius of the electron*", where photons of wavelength smaller than that radius are simply unable to affect the electron. "Their emission and reabsorption by the electron – which is what was causing the infinity at the zero end of the scale ... is inhibited by the peculiar characteristics of space-time inside the Schwarzschild radius R ".

One view of entanglement would be seeing "space islands" in the larger Hilbert space, formed by the interaction of two previously isolated particles (PLC clusters). This island would be non-aligned with the rest of macro reality, the larger Hilbert space, but inside it, with the PLs correlated and aligned between the two particles- they have their own "space matrix", so to speak. From the point of view of an external observer who has not yet touched them, they could be in any configuration – i.e. in a "superposition" of possibilities, as long as they are not aligned with the world. When they are observed (by, say pinning down the spin of one of the particles), they are then forced to align with the larger macro grid- the "superposition" disappears, and they have to pick a frame. The whole island gets aligned, so even the remote entangled particle also gets aligned, and hence the entanglement EPR effects. This is perhaps why Sclarici, Solombrino and Kossakowski find that a system described in classical QM as entangled, seems to be separable in Quaternionic QM. Classical QM insists on entangling the "wave-function", whereas QQM recognizes the independence of the particles, while being acted on by a joint operator (namely, the space connecting them). As Stapp says, "The observed system is required to be isolated to be defined, yet interacting to be observed."

Entanglement is a ubiquitous process, starting with the Big Bang where everything was in touch and correlated. However, the evolution of Space, decoherence, and continuous churn in the PL clusters will constantly "un-entangle" the patches of reality. A constant game of entanglement and unentanglement plays out against a "steady" background Spacetime aligned by the CMBR and the matter in the Universe. When we measure Entanglement in a specific experiment, we are focusing on the effect entanglement has on a specific pair of particles in their isolated patch, as it gets aligned with this

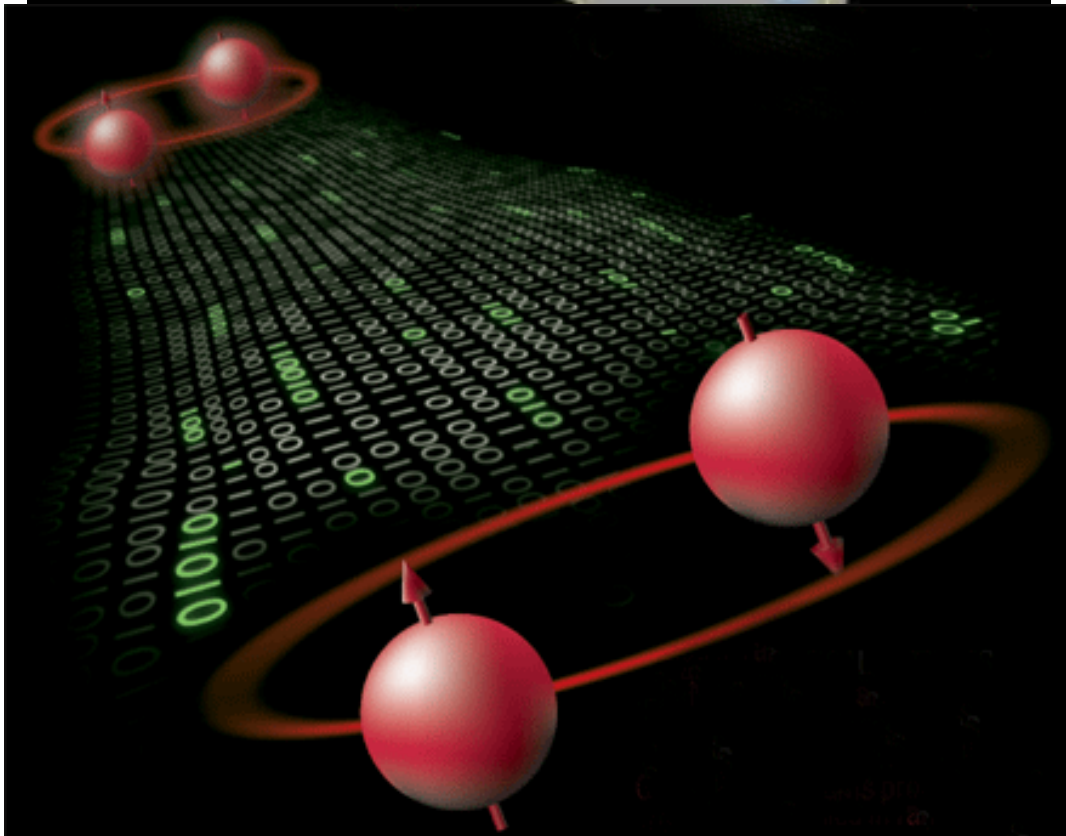
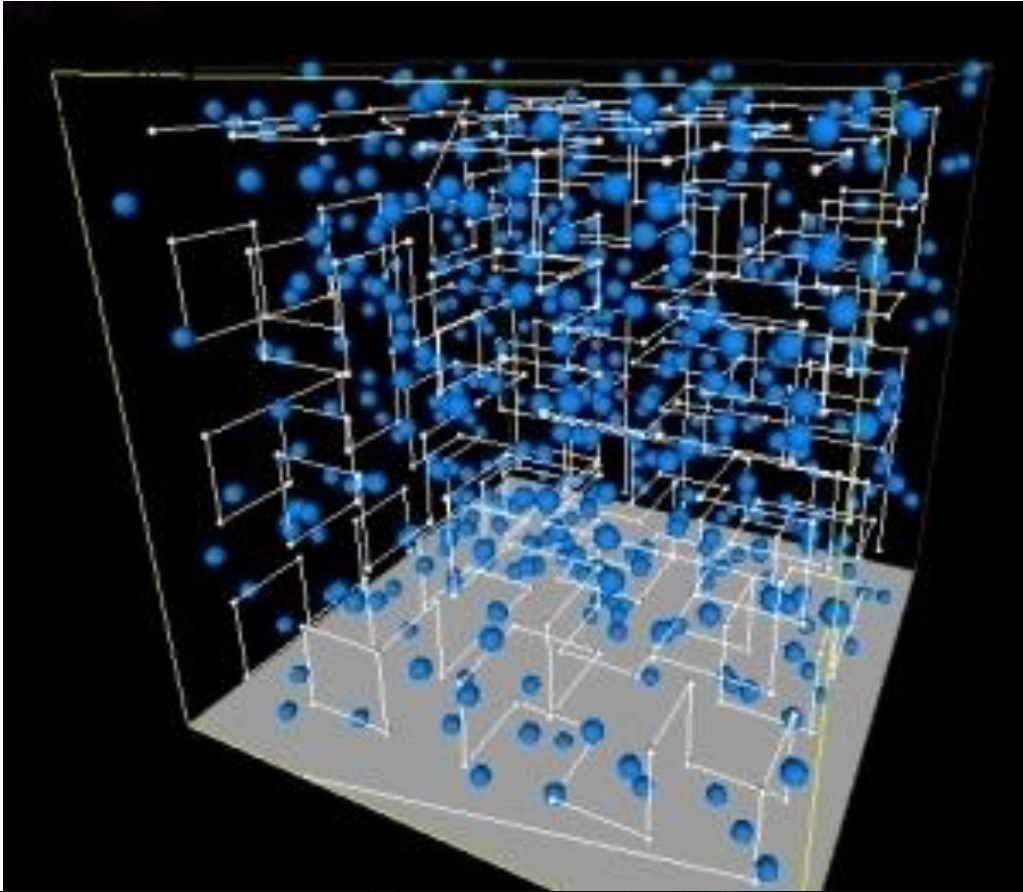
background. Once the patch is aligned with the background, classical rules follow, including the waveguide rules of Bohm-De Broglie mechanics, where the particles are still “seen to be in immediate connection, in which their dynamical relationships depend, in an irreducible way, on the state of the whole system (and, indeed, on that of broader systems in which they are contained, extending ultimately and in principle to the entire Universe). Thus one is led to a new notion of *unbroken wholeness* which denies the classical idea of analyzability of the world into separately and independently existent parts...”. Our Ontology allows us to see this physically in action, for “entanglement cannot represent “just information”. Information must be physical – anything else would be homeopathy” (Zeh).



“... Quantum Mechanics shows that nothing is ever entirely separable from everything else.” – Kent Peacock

“That the guiding wave, in the general case, propagates not in ordinary three-space but in a multidimensional configuration space is the origin of the notorious ‘nonlocality’ of quantum mechanics. It is a merit of the De Broglie-Bohm version to bring this out so explicitly that it cannot be ignored.” – John Bell

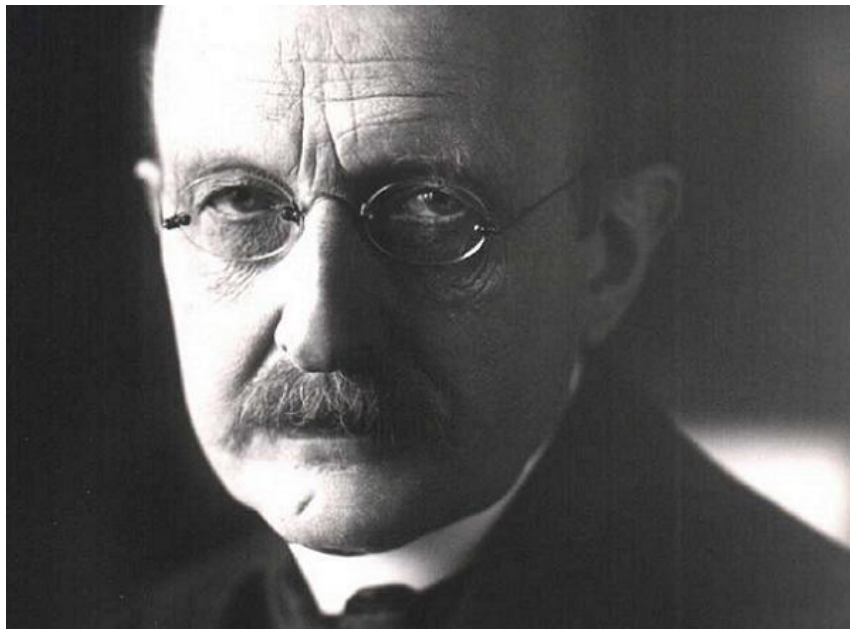
Takeaway: Entanglement is the property of sharing a common space framework, a common patch of space. Non-Locality is a product of the superluminal speed of the PL mesh, with its multiple connectivity not limited by the c speed limit.



11.3 - UNCERTAINTY & QUANTIZATION

“Planck had put forward a new, previously unimagined thought, the thought of the atomistic structure of Energy.” – Albert Einstein

Reality being ephemeral, alternating in and out continuously, uncertainty (Nature’s “Caprice” or “Willingness” – Jordan; Schroedinger’s “ignominious limit”) comes out naturally. If we posit the “Existence” Particle to be the PL, blinking in & out of existence at a planck distance (or equivalent in Existence Hilbert space), then this imposes a clear limit to the variance & continuity in the world of observation. It’s an invitation to Plato’s Errant Cause.



Max Planck

- The Quantum of Existence, the PL, forms the basis of quantization levels in Energy, and its “Clicking” in/out of Existence creates the “Quantum of Space”, being the neighboring relationship between adjacent clicks/ Nodes. Pauli, in discussing the Uncertainty Principle with Heisenberg, insists on phase-space (our PL Hilbert space) being made of h^3 magnitude/volume, for 3 degrees of freedom, and that one cannot determine a state of a particle more accurately than by assigning the phase cell. Heisenberg agreed, adding that the cell walls were also not fixed, but a relative construct of emergent “coarse” space-time.
- The Quantum of Energy, however, is the $h\nu$ energy of the Photon, where PL density has reached a saturation value in the Vacuum, causing the oscillation of the Electromagnetic field with a frequency proportional to

the “tension” in the oscillator, that tension being the PL energy level. This Quantization is only there at significant PL densities, in Photons and matter, and not present in Dark Matter and Dark Energy. The minimum “Quantum of Energy” we can observe is that constant energy nugget delivered in a single “wavelength” of the photon, regardless of frequency.

- The Quantization of energy discretizes radiation, the same way atoms discretize matter. Energy and matter being equivalent, this is only natural. This discretization, along with the discretization of Space, means nature is not continuous, at least not at the micro-scale.
- The Key to the uncertainty effects is the discretization of space, the L_p Planck Length, and the corresponding discretization of time. As Leibnitz (and later Lande) indicated, “A finite Change of effect requires a finite change in cause”. Quantization of the primary components of being (space, energy, time) will lead to quantized effects, reflected in an irreducible component in measurement that we read as uncertainty. Max Planck found the phase-space is divided into cells of size “ h ” per degree of freedom. Hence “it makes no sense to talk about a mono-chromatic wave at a definite instance in time” (Heisenberg). It does not make sense to describe the state of the system more accurately than its phase cell (of volume h^3). The zero-point energy is a consequence of this indeterminacy as well.
- Trying to measure “energy” over an instance in “time” would miss it as it oscillates in its EM world- the longer the time interval, the better chance of catching the “average”. A $\Delta E \cdot \Delta t$ uncertainty emerges. This is a counterpart of the classical $dt \cdot dv$ (v = frequency) equation. Since the minimum “Quantum of Energy” we can observe (as a photon) squeezes itself out in a sinusoidal wave in the electro-magnetic orthogonal dimensions, our “observation” (which determines the causal sequencing of time) is limited at the lower end to that minimal wave period, the energy “nugget” in one wavelength and the time it takes to propagate. The time it takes for the oscillating electric disturbance within a photon to go through one cycle is related to the photon’s energy, through $ET=h$ (planck’s constant), and hence the $\Delta E \cdot \Delta t$ limit.
- Since Photon Length (constituting a number of wavelength or nuggets) is related to the energy $E=hv=hc/\lambda$ (λ = light wavelength= hc/E), then the uncertainty in position is equivalent to uncertainty in the

wavelength as a minimum, and speed/frequency measurements which rely on that of position are equivalently uncertain. h , being a component of the calculation of lw , the least distinguishable measure, figures prominently in this uncertainty. While the above applies to Photons (and EM radiation in general), the same applies to matter, which is also localized resonant radiation.

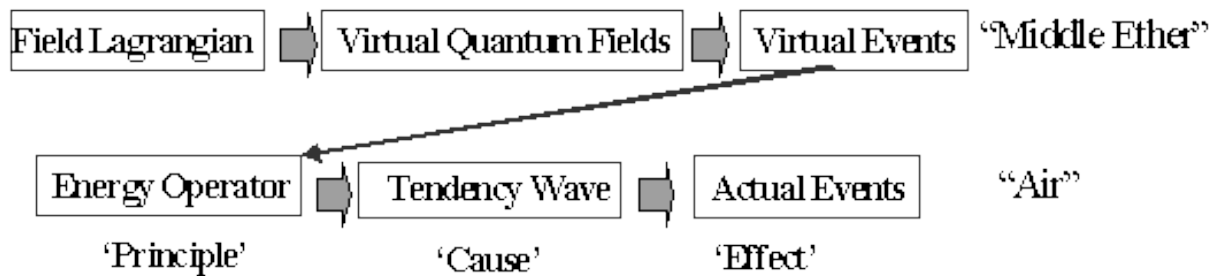
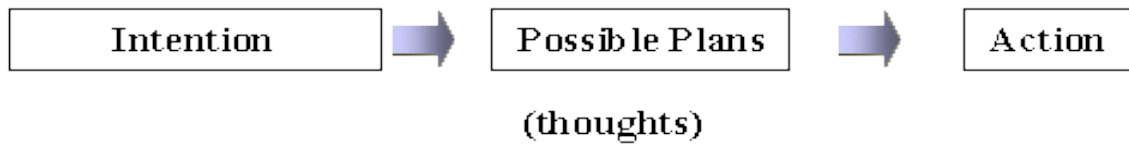
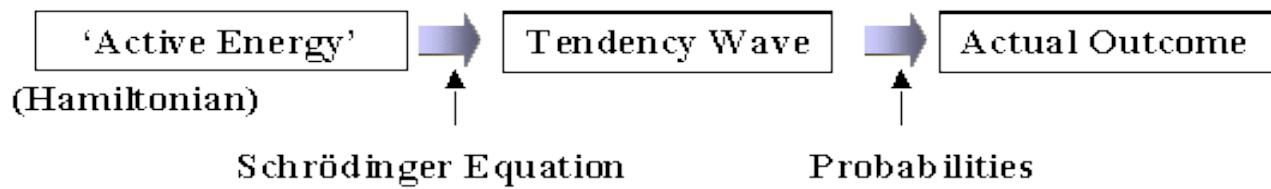
- The “wild” oscillations in the quantum world when you get close to the photon wavelength dimension is analogous to trying to put a Hurricane in a bag. Once the dimensions involved become small enough, the Photon PLs have no “room” to complete their resonant loops, and no place to escape free. They are in a unique state of high PL density, but a disrupted EM cycle, leading to the Quantum fluctuations, and mysterious behavior (since they can also behave in non-local fashion, etc.).
- Why can't we measure position AND momentum exactly? The Key is in the Existence/Reality distinction. Go back to the “isolated” particle, that exists but is not “Realized”. It is nowhere, at no time. It is in its own “world”. Try to pin it down, “realize” it at one exact spot. If you succeed, it “appears” all of a sudden, a new baby in time, with no prior history before it appeared, at least not in “our world”. With no prior history to tell how it was moving, and relative to what, its “speed” and “momentum” are an open book, since speed is measured as the rate of change of position in time. Measuring its speed AFTER it shows up will not tell you its original speed (since the act of measurement impacts the particle, changing its speed – hence the ongoing mixup you see in Heisenberg's explanation of the uncertainty, sometimes as inherent, sometimes as the result of measurement limitation). On the otherhand, trying to measure speed first, implies “realizing” the particle in several places to measure its relative rate of motion, hence repeating the conundrum. Suppes not only saw uncertainty in this, but deduced that these are not measurable simultaneously at all. ““Quantum uncertainty”, ..., expresses the fact that Nature's state vector does not have to point along the direction of any particular detector vector” (Marburger). At the Planck length and time, since we are dealing with the basic constituents of space, the “quantum” fluctuations of the metric field we use to measure space and time are higher than the “lengths” and “times”

themselves, and hence the operational definitions of time and space become meaningless.

- Looked at another way, the quantization of photon energy and momentum leads to this uncertainty. If D is the distance for the spatially periodic electric disturbance within a photon to go through a complete cycle, it is related to the photon momentum by $PD=h$ =Planck's constant. Since this D is the minimal measurable distance, it leads to the $dx \cdot dv$ uncertainty.
- Siegel used a logical axiomization to analyze "observables" and "pure states", concluding that a thorough mathematical analysis, starting from simple principles, "confutes the view that the indeterminacy principle is a reflection of an unduly complex formulation of quantum mechanics, and strengthens the view that the principle is quite intrinsic in physics, or in any empirical science based on quantitative measurements". Putnam concluded that "Quantum Mechanics is more Deterministic than Indeterministic, in that all inability to predict is due to ignorance", arising from the fact that the Quantum States themselves do not contain the answers to all the physically meaningful questions – What Zadeh would call "fuzzy states".

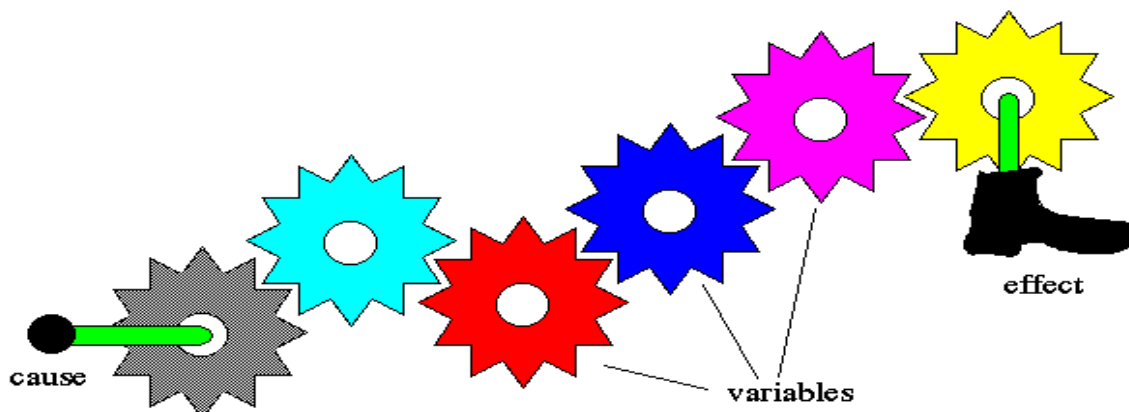


Werner Heisenberg & Niels Bohr



1 General Principle	2 Formative Fields	3 Form Spacetime	Forming Principle ‘Universal Ether’
4 Lagrangian	5 Virtual Fields	6 Virtual Events	Virtual Cause ‘Middle Ether’
7 ‘Active Energy’	8 Propensity Fields	9 Actual Selections	Actual Effect ‘Air’
Principle	Cause	Effect	

Determinism



- The “indeterminacy” of Quantum Mechanics has been exploited in building a new Quantum logic, where the old rules of classical logic do not apply (except as a special restricted case). True, False, and “Indeterminate” (as distinct from “unknown” – it is unknowable in principle, even to “Laplace’s Superman”) come into play, and the resulting computing logic, once fully mastered, could lead to great improvements in computing power and perhaps to a better understanding of the “Old One’s” secrets. This “non-Boolean” logic is an empirical logic, a conceptual revolution brought about by Quantum Mechanics, liberating logic from being an Aristotelian “A Priori” formal discipline to an empirical science capable of explaining “true” nature. The final revolution against Aristotle’s hold on Science is afoot.
- The disjunction in Quantum logic from classical logic parallels the disjunction between Einstein’s Relativity and Newtonian Mechanics. As David Finkelstein would say, the departure from Euclidean Geometry necessitated by speeds close to the speed of light, resembles the departure from the “distributivity” of classical logic at the microworld, both realms being outside our normal experience. Putnam declared that what in the past had been regarded as “necessary Logic” may turn out to be False on empirical ground – the epistemological situation in geometry (Relativity) a perfect analogy for the epistemological situation in logic. Once we have a new Quantum Logic, the Quantum rules mathematically follow. Watanabe emphasized that our inferences and decisions in everyday life are usually probabilistic, and rarely come with certainty. Our Logic is Quantum whether we know it or not – it is empirical, provided “empirical” includes “what the living beings have learned during the long years of evolution”. Classical Physics, as von Weizsacker says, “simply describes the approximation to quantum theory appropriate to objects as far as they really can be fully observed”, Quantum Mechanics becoming semantically meaningful only in terms of classical physics, as Bohr insisted.
- Finkelstein takes this Quantum logic a step further, building a quantum topology, based on the quantum non-distributive logic of reality. He proposes nature as a quantum computer (his Qunivac, with science being an attempt to hack it ☺). It resolves the classical space-time underlying Feynman diagrams into a quantum network of creation and annihilation processes, reducing kinematics to quantum statistics. In

this process approach, the action in the Universe lies in “events”, and not things. Time, Space, and the rest are defined by these “events”, from which those concepts arise – process (codon) being “fundamental at the microscopic level and spacetime and matter as semimacroscopic statistical constructs akin to temperature and entropy”. “A particle process is just a significant bundle of strands in such a network, and spacetime relative coordinates and proper times are statistical characterizations of the strands joining two junctions”. Recalling Von Neumann’s view that our mental constructs of reality (which result in classical logic) are misaligned with experience (in QM, and increasingly in macro contexts), he sets about to build the equivalent of Einstein’s relativity for Logic, realigning our thought processes along the newly discovered mysteries in a new domain.

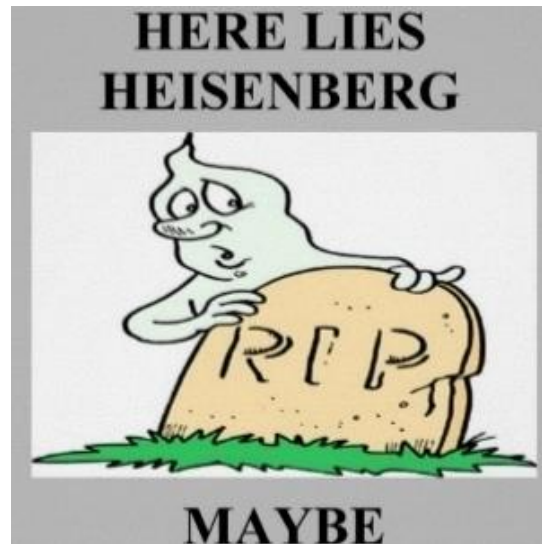
- As Thomas Chen says, “It is actually a very deep insight that in all natural phenomena where some form of wave propagation occurs, there is a kind of a Heisenberg uncertainty principle. Something that is not widely known except among mathematicians working in the field (I am quite sure, not even among physicists), is the following fact: The Heisenberg uncertainty principle is NOT a mysterious physical law special to quantum mechanics, and discovered by Prof. Heisenberg, which is inexplicable and mysterious. This is in contrast to the Schroedinger equation, which is truly as miraculous as nature itself. The truth is: The uncertainty principle is a generally valid mathematical theorem in the theory of Fourier analysis (this mathematical field is called harmonic analysis, a deep and beautiful area with many surprises). It states that the product of the standard deviations of any pair of conjugate Fourier variables (e.g. wave vector and wave position, or energy and time, or frequency and time, etc.) is bounded below by 1 (depending on normalization with factors like pi, etc.). Whenever you are given a physical system described by Fourier theory, of which wave propagation is a prominent example, you will ALWAYS have an uncertainty principle. The catch is to find out how it must be formulated.” Heisenberg had seen this as a directly visualizable explanation of the relation $pq - qp = h/2\pi i$, and an analogy to Special Relativity, where the microworld observables differ the same way high speed observables do in SR.
- Bohr stated his view simply and convincingly at the Solvay Conference in 1927 (quoted by Ehrenfest): “from pure wave kinematics the

following uncertainties $dt \cdot dv = 1$. The shorter the time duration at a wave signal, the greater the uncertainty in the definition of its frequency... Further, from this result, on account of the Planck-Einstein relation $e = h\nu$, $p = h/\lambda$ (momentum), the ‘reciprocal uncertainty relations’ $dt \cdot de = h$, $dx \cdot dp = h$ ” arise for light. Furthermore, using the conservation laws in the interactions between light and matter, the same can be transferred to matter.

- I am generally hard on Bohr’s direction of the Copenhagen view, but the following quote in his notes at Solvay has a redeeming value: “As regards [the] general problem I feel its difficulties. I would put [the] problem in [an]other way. I do not know what quantum mechanics is. I think we are dealing with some mathematical tools which are adequate for [the] description of our experiments. Using a rigorous wave theory, we are claiming something which the theory possibly cannot give. [We must realize] that we are away from the state where we could hope to describe things on classical theories. ... I think we are actually just trying to meet, as in other theories, some requirements of nature, but [the] difficulty is that we must use words that remind [us] of older theories. The whole foundation for [a] causal space-time description is taken away by quantum theory, for it is based on [the] assumption of observations without interference [between the object of observation and the subject of observer]; excluding interference means exclusion of experiments and the whole meaning of space and time observation... because we [have] interaction [between object and measuring apparatus], and thereby we put [ourselves] on a quite different standpoint than we could take in classical theories. If we speak of observations, we play a statistical problem... The saying that space-time is an abstraction might seem a philosophical triviality, but nature reminds us that we are dealing with something of practical interest.”
- Heisenberg concluded: “the situation is this: one *cannot* say that quantum mechanics is statistical. However, one can obtain only statistical results, if one wants to calculate ‘future events’ from the ‘present’, since one cannot take into account all the initial conditions of the present.”
- Aside from this, the remaining uncertainty emerges from the “Random” Chaotic behavior of PL Pilots guiding the PLC waves. That behavior is akin to the random Gas thermodynamics, deterministic but chaotic – its

“Butterfly Effects” hard to compute and model. God may be infinitely creative, but he does not play Dice, as Einstein insisted.

- On a lighter note, Tryggvi Emilsson thinks *“Historians have concluded that Heisenberg must have been contemplating his love life when he discovered the Uncertainty Principle: When he had the time, he didn’t have the energy, and, when the moment was right, he couldn’t figure out the position.”* ☺



“It is not possible that the world is not discrete... if space-time is discrete, the velocity in a point has no significance because in order to define the velocity in that point, we need a latter point infinitively near the former: this is impossible in a discrete world”.

- Heisenberg

“One can look at the world with the p-eye or with the x-eye, but if one wishes to open both eyes at the same time, one goes wrong”. - Wolfgang Pauli

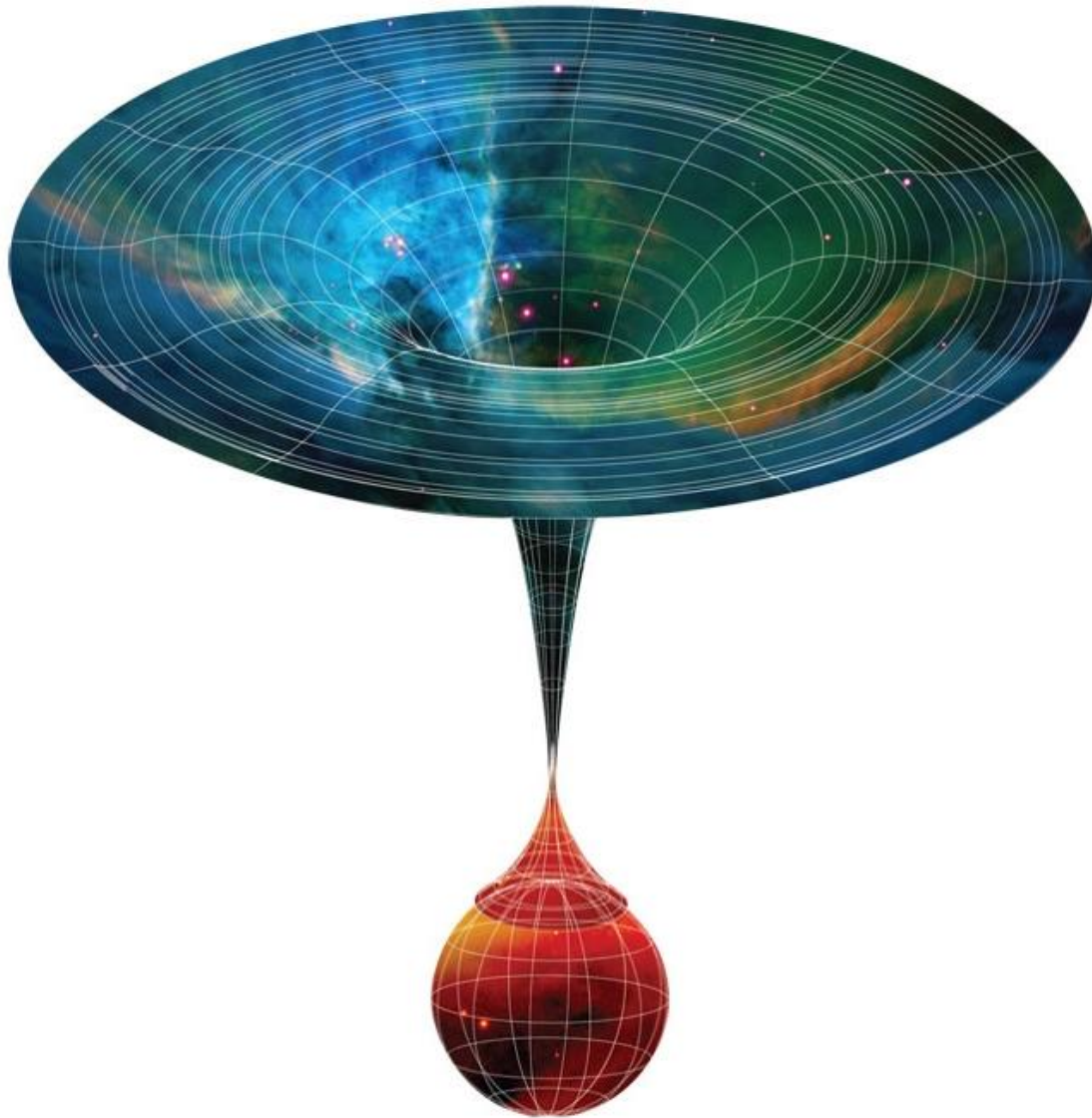
“...quantum mechanics, in its present state, appears to be mysterious. It should always be the scientist’s aim to take away the mystery of things. It is my suspicion that there should exist a quite logical explanation for the fact that we need to describe probabilities in this world quantum mechanically. This explanation can presumably be found in the fabric of the laws of physics at the Planck scale.”

- Gerard ‘t Hooft

Takeaway: Uncertainty is a natural result of the wave nature of matter, limiting our focus to the wavelength observed. It is tied to Quantization of space, time, and energy, being a result of the discreteness of the PL world, and the energy nuggets of the PLC photons.

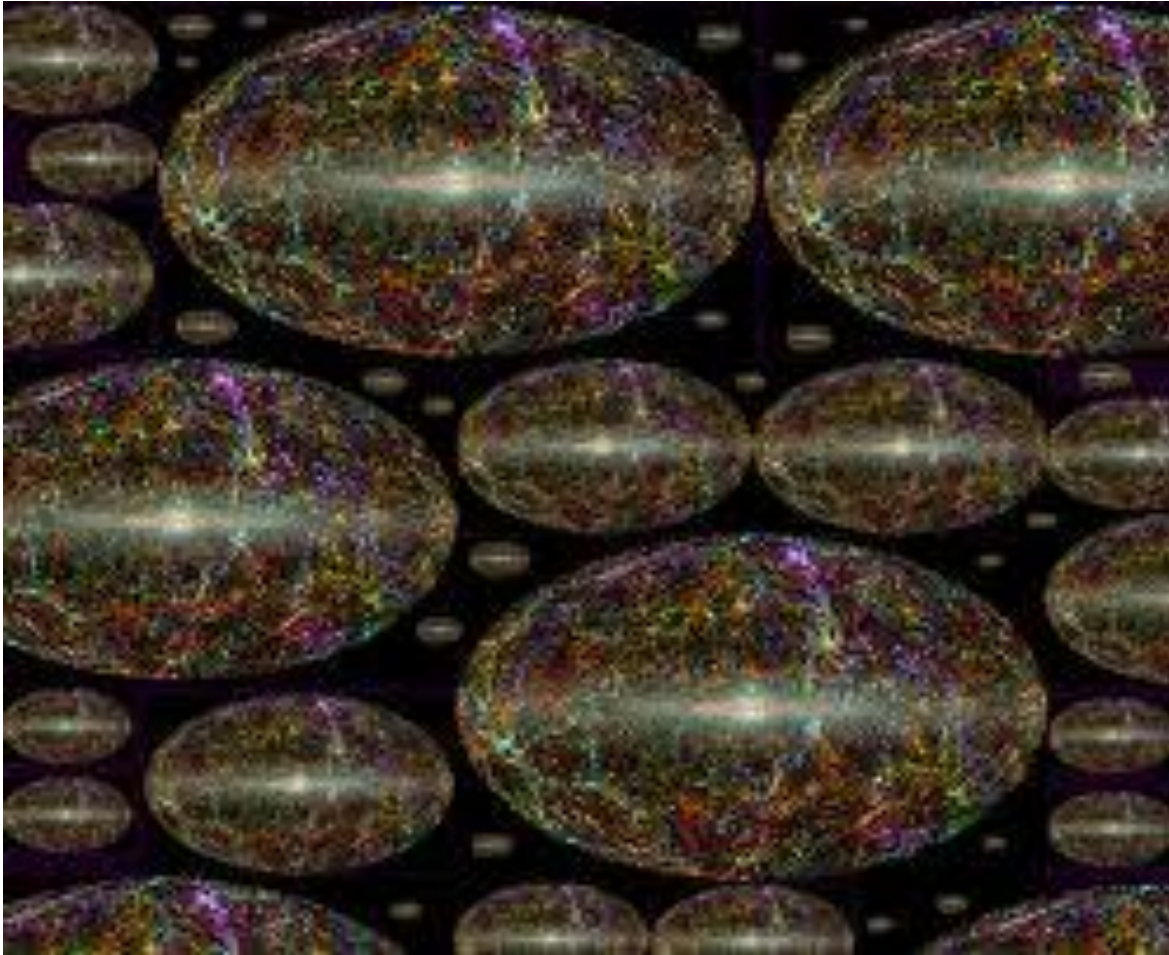
11.4 - PARALLEL WORLDS

Even though the Hilbert space of existence we have described “stabilizes” in a three dimensional space, there is no reason that the infinite dimensional Hilbert space cannot form multiple “3-dimensional” worlds out of its many other dimensions. This is one possible mode of the Multi-Verse or Bubble-Universe picture. The Black-Hole scenario of new Universes created at the singularity would also go into this infinite dimensional model.



As Steven Weinberg says, paraphrasing Churchill, the “Many worlds” idea is a “miserable idea, except for all the other ideas”.

Separate PL clusters would group into three dimensional arrangements, worlds of their own. It would follow the same “ground rules” of the Netherworld, PL formation, etc, but its “Game of Life” formation would develop on its own, contingent on initial conditions and the randomness of PL creation and interaction.

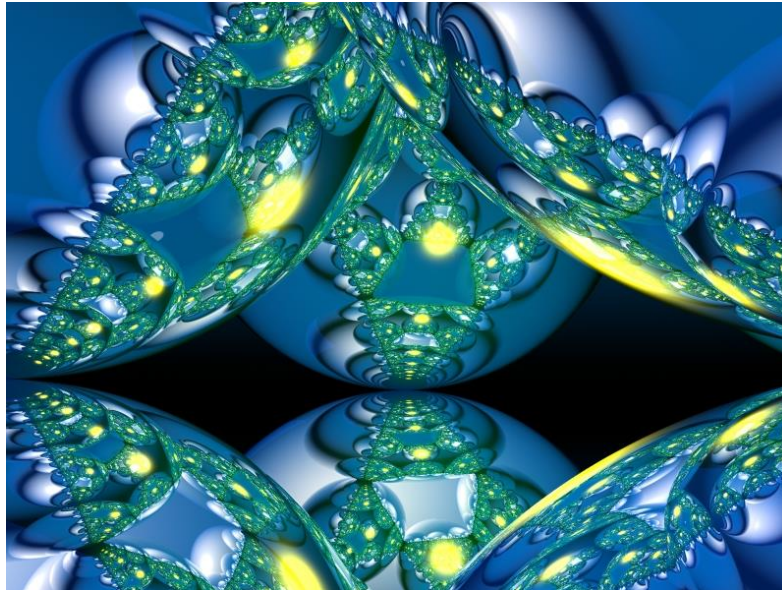


Each one of these worlds would parallel ours, evolving along similar lines, perhaps with similar or different configurations. Their Hilbert clusters would be “distant” from ours, with no normal interaction between the two.

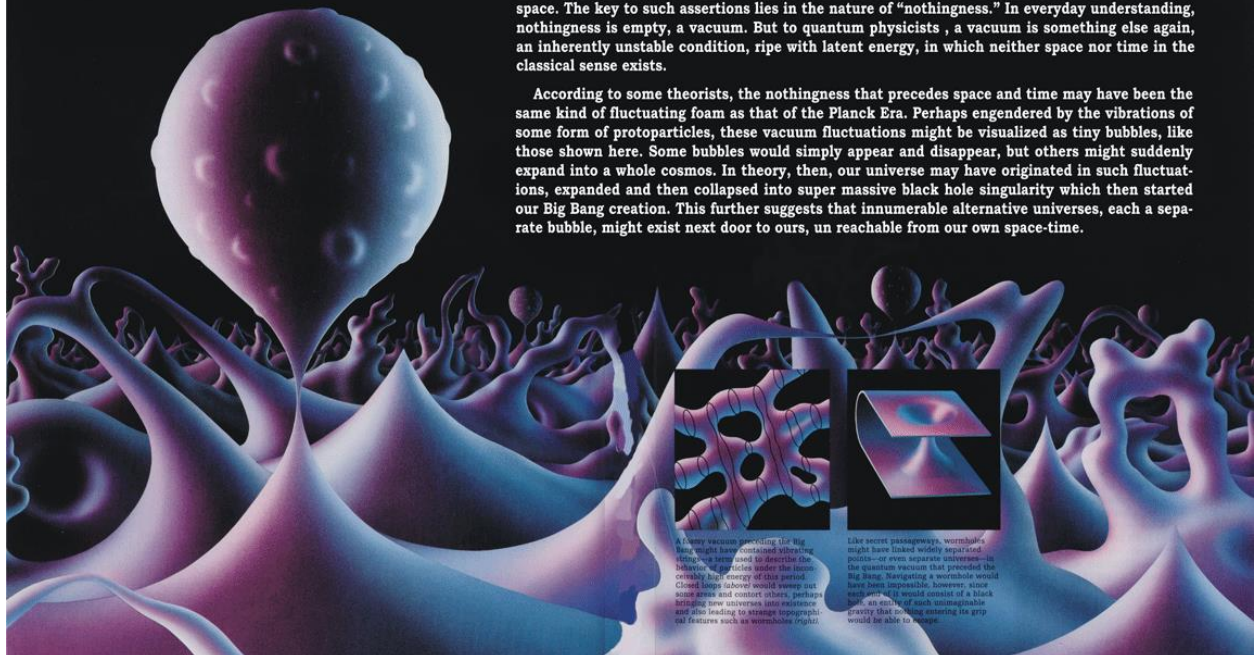
This would be similar to the Brane concept, our world being a three dimensional island floating in a higher dimensional cosmos.

Some have proposed creating those Baby Universes in the lab, focusing sufficient energy at a single point to start an “inflation”. They hypothesize planck size “foam” (our equivalent PLs popping in and out of existence, creating local PL “clouds”) could start spawning their own “space” and hence

baby Universe (the PLs evolving a separate cluster in the Hilbert Space), the “Inflaton” (a heavy hypothetical particle, perhaps a particular dense PL cluster formation) destabilizing the local space-time mesh and causing the bubble to grow and expand. Since our PL world is formed by those PLs popping in from the Netherworld, creating local “space” mini-meshes that would look like space-foam (which normally are small and transient), eventually creating the whole Universe, then these ideas align with that hypothesis.



BUBBLING OUT OF NOTHINGNESS



Efforts to solve one problem in cosmology often open up a Pandora's box of others. For instance, speculations about the universe immediately after the Big Bang lead almost inevitably to considerations of what came before. One hypothesis is that the cosmos originated from nothing, or—more extraordinary yet—it may be one of countless universes that have materialized out of empty space. The key to such assertions lies in the nature of “nothingness.” In everyday understanding, nothingness is empty, a vacuum. But to quantum physicists, a vacuum is something else again, an inherently unstable condition, ripe with latent energy, in which neither space nor time in the classical sense exists.

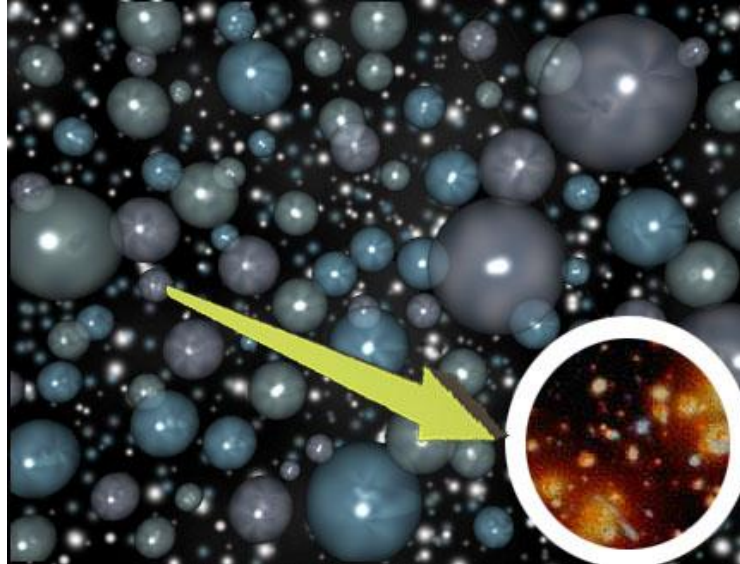
According to some theorists, the nothingness that precedes space and time may have been the same kind of fluctuating foam as that of the Planck Era. Perhaps engendered by the vibrations of some form of protoparticles, these vacuum fluctuations might be visualized as tiny bubbles, like those shown here. Some bubbles would simply appear and disappear, but others might suddenly expand into a whole cosmos. In theory, then, our universe may have originated in such fluctuations, expanded and then collapsed into super massive black hole singularity which then started our Big Bang creation. This further suggests that innumerable alternative universes, each a separate bubble, might exist next door to ours, unreachably from our own space-time.



A tiny vacuum fluctuation, the Big Bang might have consisted of a tiny, vibrating energy of this period. Clouds of energy would sweep out some areas and contract others, perhaps bringing new universes into existence and also leading to strange topographical features such as wormholes (right).

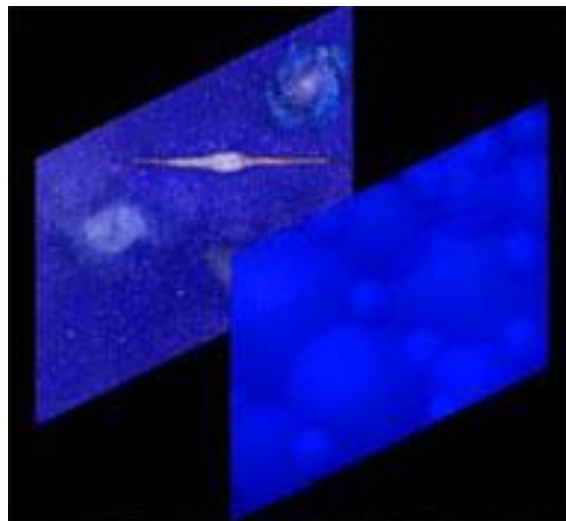


Like secret passageways, wormholes might have linked widely separated points—or even separate universes—in the quantum vacuum that preceded the Big Bang. Navigating a wormhole would have been impossible, however, since each end of it would consist of a black hole. As a result of such unimaginable gravity that nothing entering its grip would be able to escape.



It is, however, not impossible for these separate worlds to interact. This could happen in one of two ways:

- Spurious “jumps” in the Hilbert space of one world’s PLs would move them to the Hilbert Cluster of the other world. This would be a rare and low energy effect, with likely unnoticeable impact in our world.
- A controlled jump via “wormhole” technology, that can initiate a “shift” in a local part of the Hilbert Space, moving it suddenly into another cluster, and moving any particles or beings within that local space to the other Universe. This would require a thorough understanding of PL formation (the “Vacuum Energy”), drift algorithms in Hyperspace (QM), as well as Relativity and Thermodynamics to maintain a stable environment during the shift.



- A gradual “slide” of one world’s overall Hilbert space, leading to a “collision” of the two clusters. This would be the Ekpyrotic (Big Splat) scenario fancied by some String Theory proponents- Branes colliding, with massive impacts on both worlds, as their PLs and Energy overlap, simulating the effects of the Big Bang. This scenario was recently falsified (for our Universe, at least) by the detection of Big Bang Gravitational waves.

Everett and Deutsch’s many-worlds scenarios evolving from our own, driven by the wave-equations of QM splitting along its many probable paths, could also be envisaged as multiplying patterns in the Hilbert space, recollapsing to “our” pattern by decoherence or otherwise, but possibly branching out to a separate plane. Weinberg’s analogy to multiple radio stations in the ether, with the one we’re listening to being the one that decohered, is a good start. I personally find this a profligant scheme, and Nature is more miserly than to indulge in it, even though it is feasible- besides, the number of radio stations does not grow exponentially everytime we touch the knob ☺. Everett had said: “The Copenhagen Interpretation is hopelessly incomplete... as well as a philosophical monstrosity...”. I agree, but unfortunately, the last part of his statement also applies to the Many Worlds view. Leggett considers it “simply a meaningless collage of words”, while Mermin calls it “the cloud-cuckoo-land of many worlds”.

A Multiverse view is more probable, an infinity of worlds of mathematical entities. Tipler considers the cardinality of the universes in the multiverse is the cardinality of the continuum, with all 25 constants in the extended Standard Model of particle physics assuming all possible values of the continuum somewhere in the multiverse. Penrose predicts our world has a limited information content – $10^{10^{123}}$ bits, and as such, in an infinity of worlds, many will repeat. Maybe my doppelganger in one of those worlds knows the answer.

The options are endless, and so I assume will be the debate.



A 5th dimensional perspective

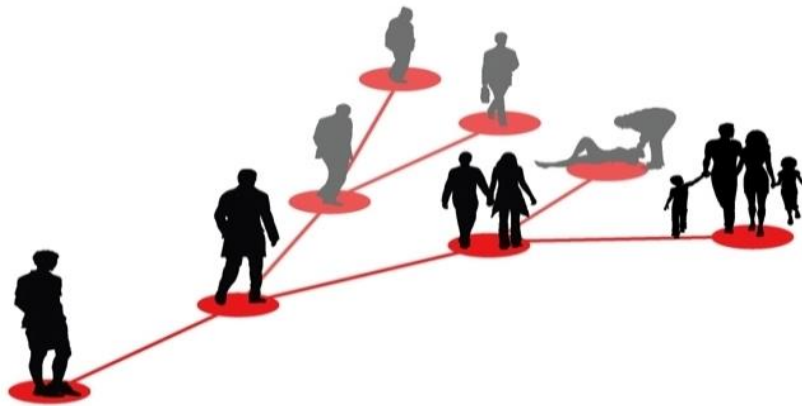
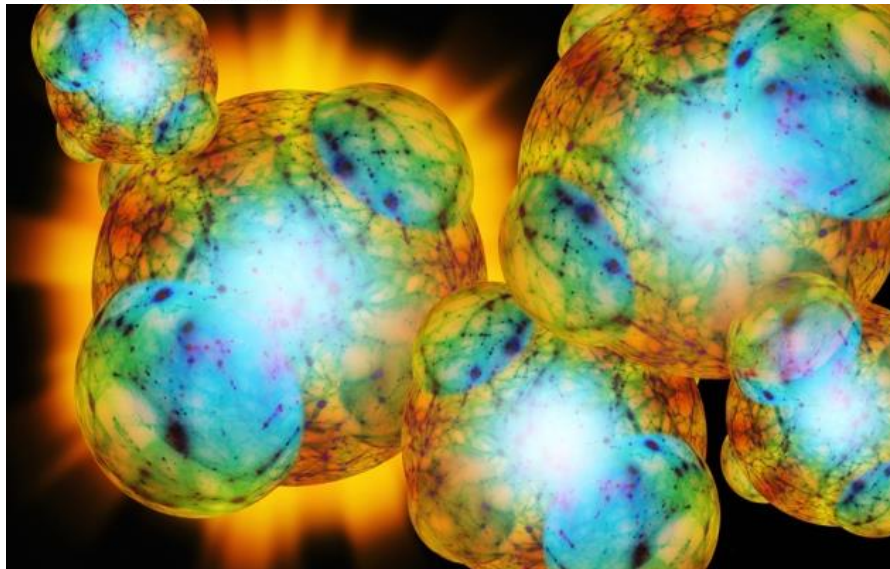
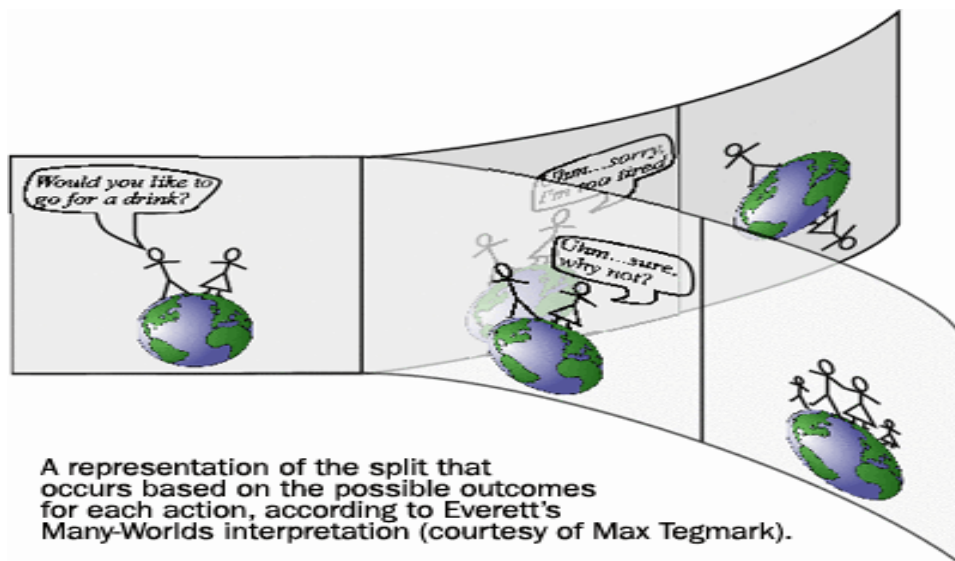


Illustration of diverging timelines



Multiverse Bubbles



A representation of the split that occurs based on the possible outcomes for each action, according to Everett's Many-Worlds interpretation (courtesy of Max Tegmark).

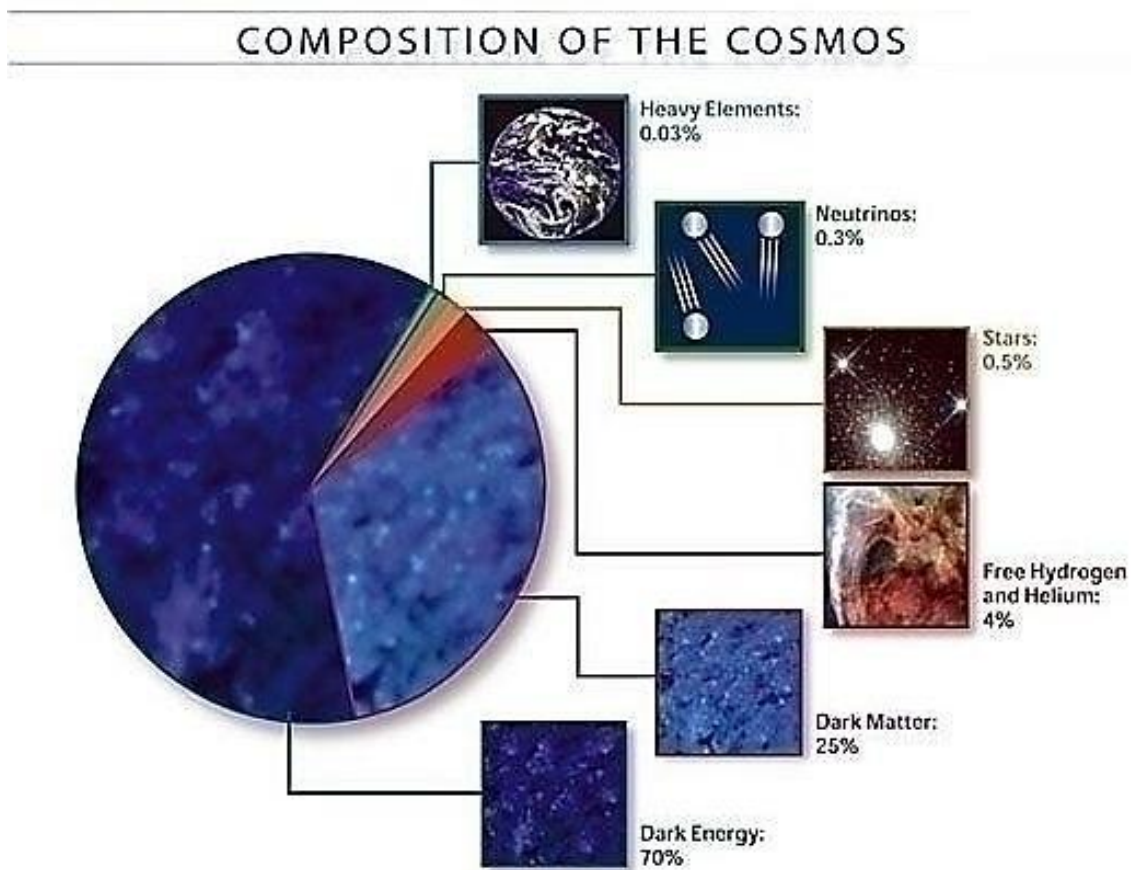
13 - THE DARK SIDE

13.1 - THE VACUUM

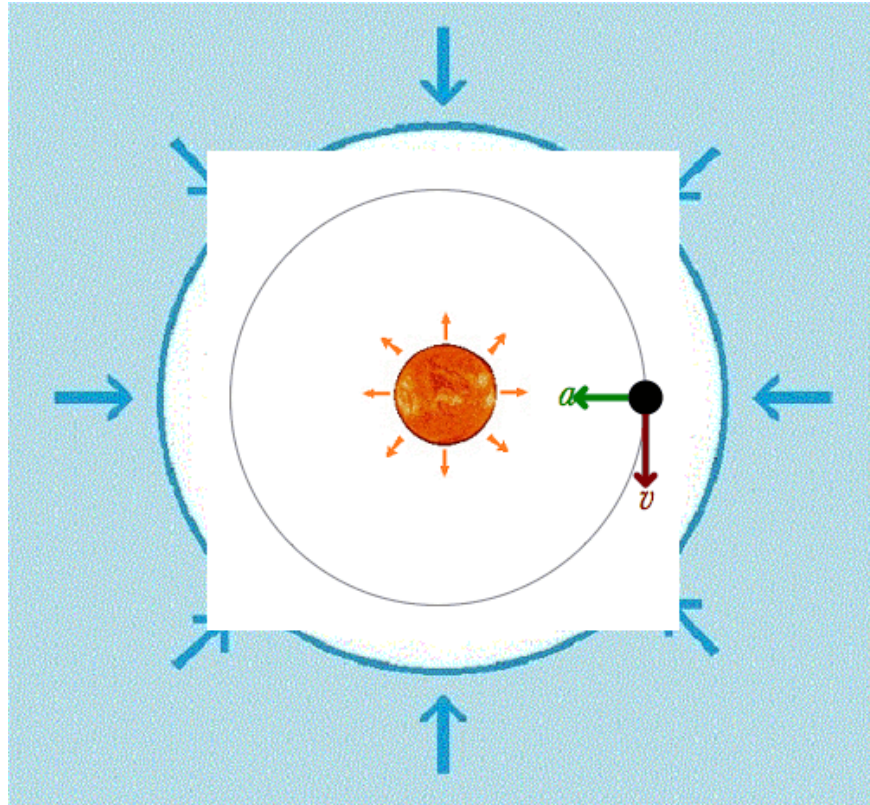
As Wittgenstein reiterated repeatedly, our words tend to limit us and conjure our thoughts, misleading us along the way.

The Vacuum is anything but. It is not the Emptiness, Nothingness. It is a distinct presence, the fabric of space formed by the PLs, within which our Universal play is acted out – it is the Buddhist Sunyata, the living Void.

The PLs in the Vacuum are the same stuff everything else is made of. There just is less of them around, so it seems lonely out there. When PLs congregate, they form a Party, and Particles are born- the Matter we know and are made of. But we occupy a very small portion of the “Vacuum”, and the rest is that Dark domain, bereft of Light (except for the occasional streaking Photon). It is the “Deep”, with a light smattering of the Light yet to aggregate and shine forth.



The “Vacuum” is not inert. It is a Dynamic medium that manifests itself in virtual particles (that can be turned to real particles if energy is supplied; and that affect the apparent charge of real particles by their screening effects), the Casimir Effect, and the Lamb shift. QM thinks it a raging sea of energy... when it actually seems rather like a wet surface for our stage. Some (Sorli) link its impact on Gravity to the interaction with Dense nearby matter- the warp of matter in the Vacuum (space) producing the gravitational effect (below).



“A vacuum is a hell of a lot better than some of the stuff that nature replaces it with” – Tennessee Williams

Takeaway: The Vacuum is our PL Ether

13.2 - DARK MATTER

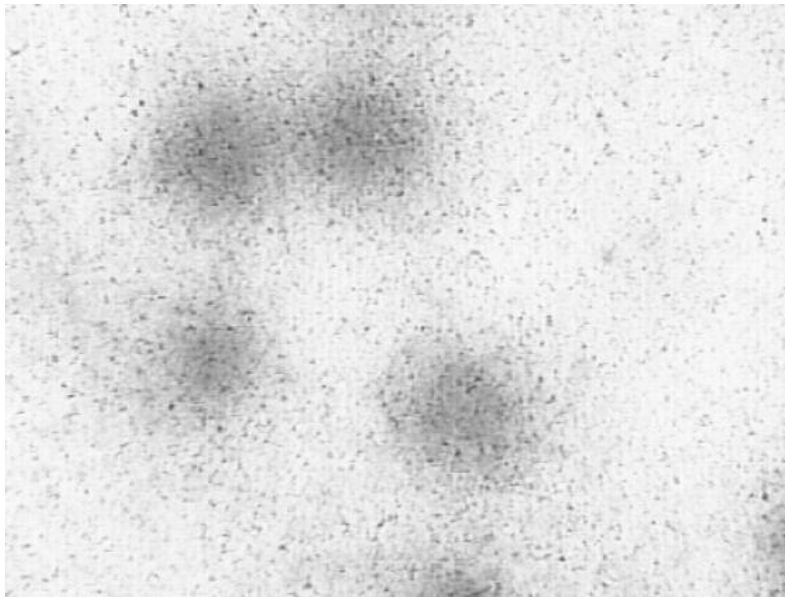
Perhaps the clusters of Stars and Galaxies would excite a synchronous “rippling” effect in the surrounding space, exciting the vacuum oscillations, at a low excitation rate (PL creation density level) we would not “see”, but never the less affect space in such a way to present us with the “Dark Matter” whose effect we observe. It could explain away and un-justify Milgrom’s MOND proposals.

Basically, we propose that concentrations of PLs (energy and matter) tend to increase the PL generation rate (the same generation that created the vacuum and is expanding the Universe as Dark Energy). A type of “resonance” effect causes this PL generation increase, which accumulates at low levels, providing its gravitational effect as Dark Matter, but not detectable otherwise.

- This is why the Dark Matter is around the Galaxies, and not in the intervening “empty” (read low PLC density) space.
- The “Gravitational” effect of Dark Matter PLs (as opposed to the expanding effect of Dark Energy) is purely due to the additive effect it provides to the “Warp” around Galaxies, whereas the Vacuum Energy (Dark Energy) is in a flat space environment, providing its matrix enhancing expansion effect without causing warping.
- Fluctuations in the Dark Matter density could lead to sufficient size PLCs to initiate the Photon cycle, launching light. These fluctuations could also cause the yet-unexplained “Space Roar”.
- This dark matter could be the sought after “light” super-symmetric particles. This “LSP” would be the way this light-density matter is configured. While Super-Symmetry theories predict various values (including high mass), it does not describe the structure of the particle.
- What would it take in PLs per node to cause the Dark Matter effect? If we take the calculated mass of the Dark Matter, divide by the volume of the Halo around a typical Galaxy (Milky Way as an example, with a radius of 50,000 Light Years), we can estimate the PL density required. Appendix I gives us 7000 PLs per node, a relatively low density over the 1 PL/node of the vacuum Dark Energy, but sufficient around Galaxies to cause the gravitational effects observed. However, compared to Neutron densities of 3×10^{44} PLs/node, it is peanuts. Similarly when compared to photon densities. At low densities, particles cannot sustain their

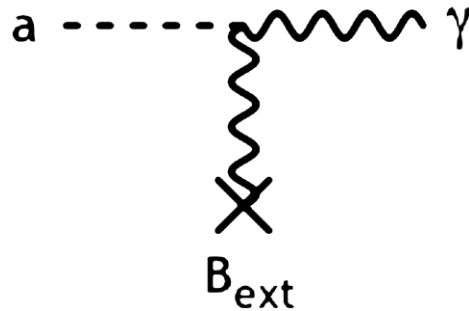
patterns, and diffuse again into the PL Sea. No wonder it does not interact and cannot be directly observed- hence the “Dark” label given to the **Galactic Vacuum**.

- Axions, hypothetical particles of the Core theory (Standard Model unified with Gravity) are a leading candidate for Dark Matter clusters. Big Bang models show them being produced with the right density, and their weak-interactions model the behavior of Dark Matter appropriately.



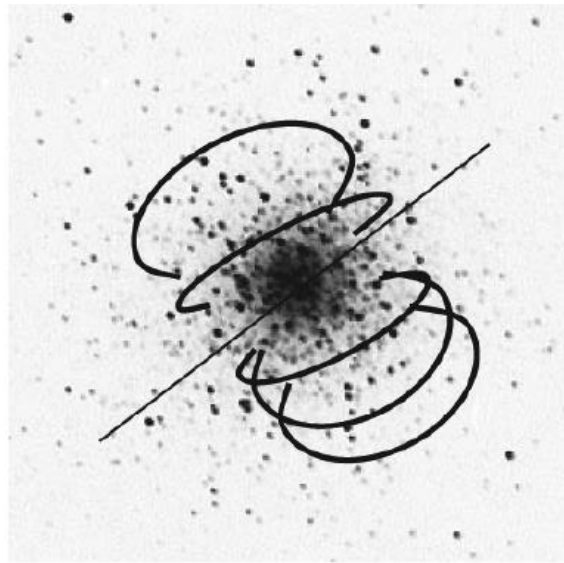
Unexplained “dots” in X-ray pictures from Shpilman Axion-Generator (using Primakoff Effect) (Benford, Journal of Theoretics)

- Our view of PL “resonances” in the vicinity of dense matter (“normal matter”) clusters explains the presence of this Dark Matter around agglomerates of matter as in Galaxies, outweighing the normal matter 5 to 1. Its non-uniform distribution indicates its origin as a by-product of or a pre-cursor of “Normal” matter. Axion theories show the Primakoff effect where Axions can be generated from Photons; equivalently, a reverse-Primakoff effect can convert Axions back to Photons (normally decays with a lifetime of 10^{50} yrs). Our PL Clusters can “disband” into Axions, or re-group into EM radiation. PVLAS experiments shows axions being created from photons in strong magnetic fields, and “shining light through a wall” experiments are pending to verify this effect. The Axions are expected to be free-streaming particles, with features similar to neutrinos (another dark matter candidate).

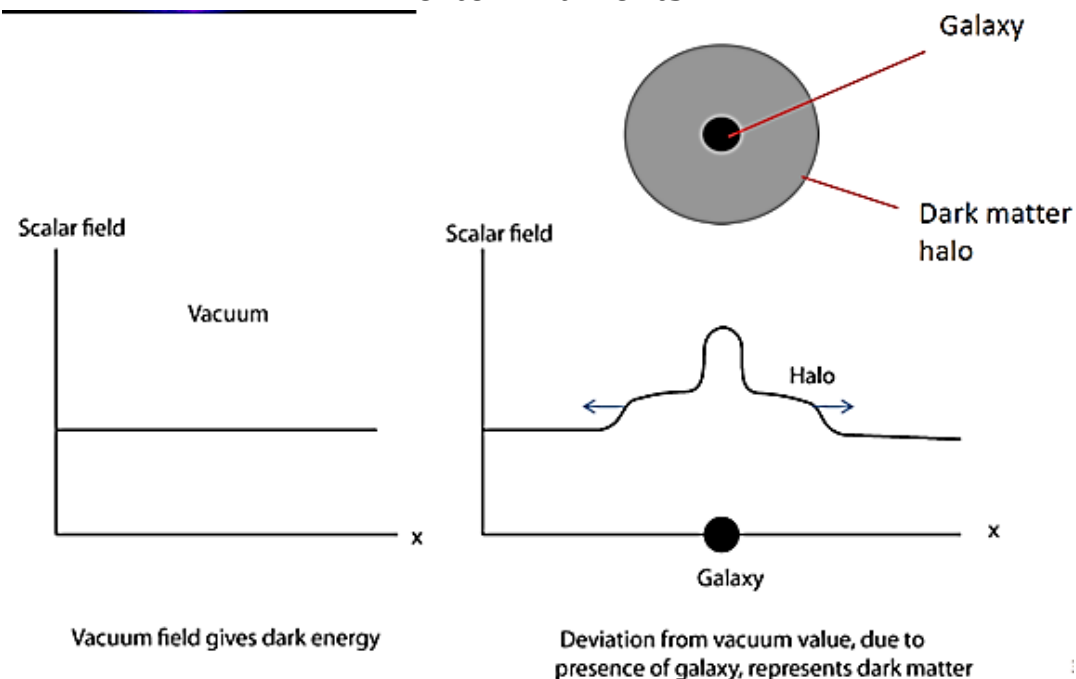


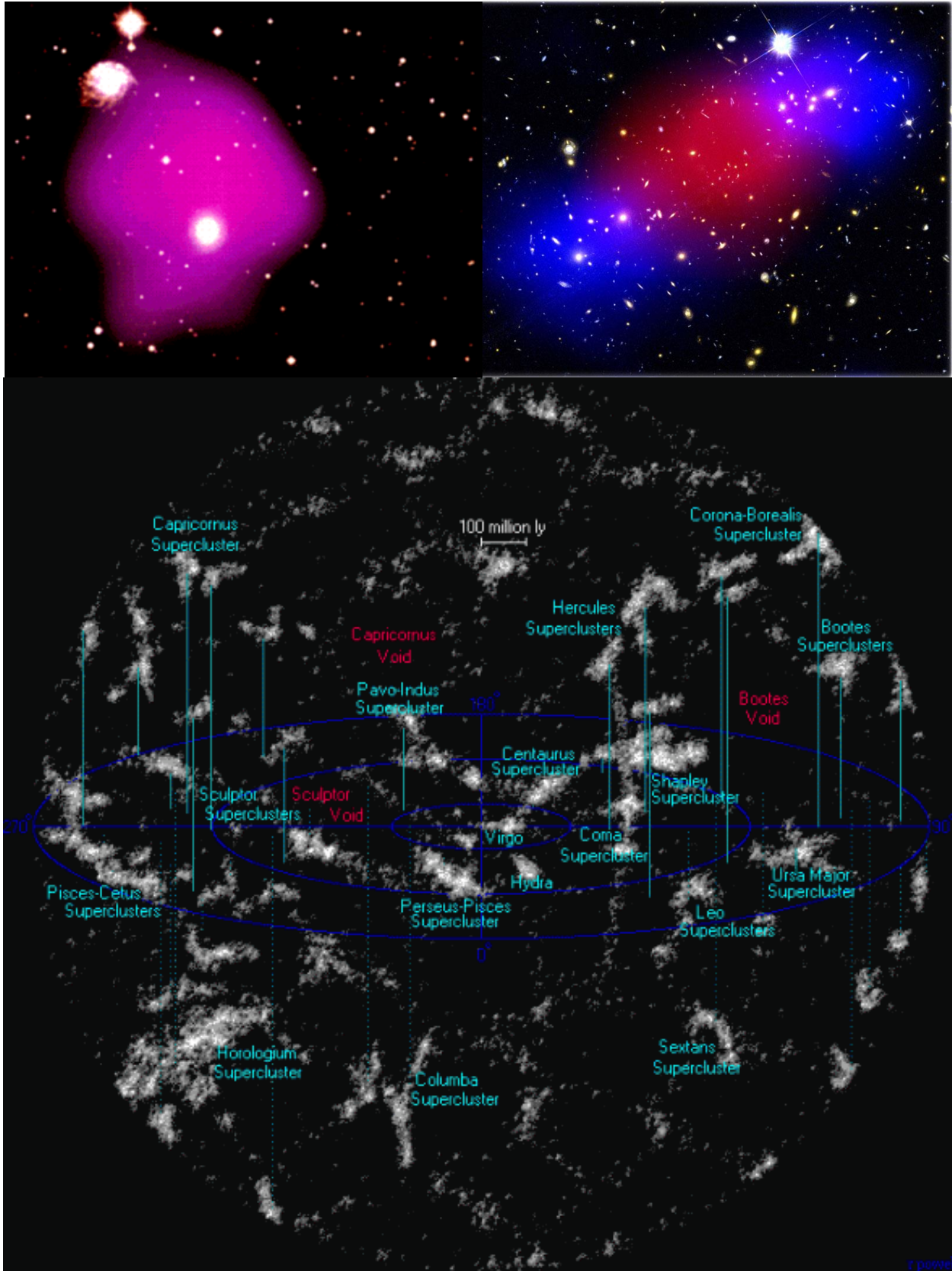
- Recent theories of dark matter being astronomical size particles, resulting from the same scalar fields that give us our Dark energy (Quiros, UCLV), also coincide with the PL picture. Those particles would have very small masses (about 10^{-23} ev), and participate in the formation of mass structures like Galaxies – hence their presence around them. Their mass would be equivalent to about 10^{-60} kgs, right in the expected axion range. And within range of our low proposed Dark Matter density in PLs when spread over a large volume, acting like a form of giant Bose-Einstein condensate. All roads, it seems, lead to Rome.
- One more thought: What if the Dark Matter is the PLs of the wavefunction – the Pilot PLs, spread in 3-D space while the particle PLs are in the extra dimensions? The cumulative set of Pilot PLs form the shape of the 3D mesh, which describes then gravity. Our appendix shows a Dark Matter density overall of 7000 PLs/node; while matter density (say neutron) is of the order of 10^{44} PLs/Node. Their ratio is about 10^{40} , roughly the scale variance between the strength of EM and Gravity, and the same ratio shows between quark/antiquark condensate calculation for Vacuum Energy & the observed value ... coincidence? EM effects in the higher dimensions would outweigh the 3D projected impact of gravity by roughly the right ratio, Gravity being a “leak” of the EM PLs into the 3D space from the EM dimension, warping the 3D space, but out of proportion to the EM warp. Just a thought.
- Kerson Huang describes a Vacuum complex scalar field that makes the Universe a Superfluid. This Superfluid provides both the Dark Energy aspects (in its “flat” “background mode”), and the Dark Matter component, basically seen as “Vortex Filaments” that result from rapidly rotating objects (those Matter objects themselves being the product of

the Vortex “tangle”, like our rotating PLC Cluster). Since these Vortex Filaments (which can be demonstrated in macroscopic Superfluid experiments) are tied to the presence of Matter, the Dark Matter Halos tend to surround existing Matter clusters, like Galaxies and Stars. The superfluid is home to phonons and particles coupled to the superfluid, excited from it, providing the elusive WIMPs. Cosmic superfluidity arises from a vacuum complex scalar field, and all matter is created from quantum turbulence in this fluid.



“Vortex Filaments”





13.3 - DARK ENERGY

“Form is emptiness, Emptiness is Form” - The Mahayana “Heart Sutra”

“The Tao of Heaven is empty and formless” - The Kuan-tzu of Taoism

If we consider the Dark Energy to result from an average of 1 PL per node (Any higher density diffusing over time to create more nodes), space being close to an equilibrium state now, then we can calculate the Dark Energy of the Universe by Multiplying the volume equivalent of PL nodes by the PL energy, and vice-versa.

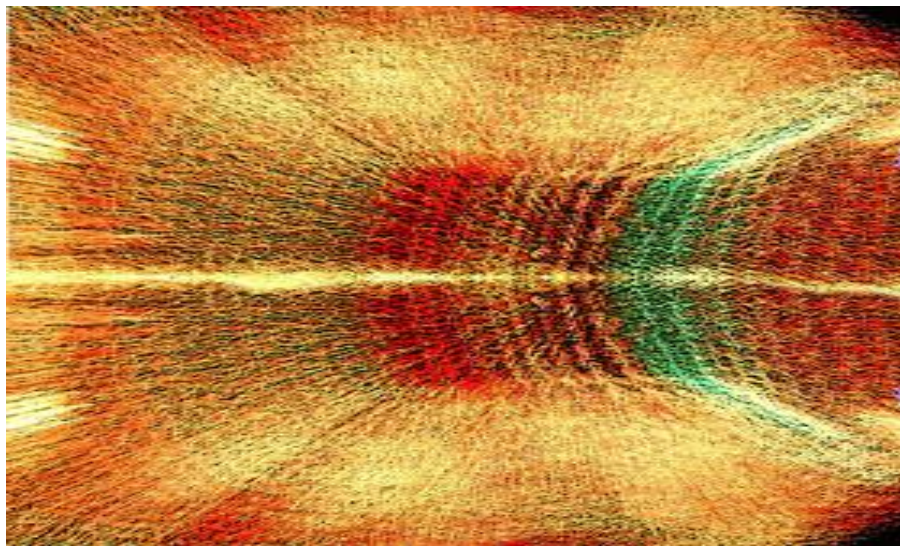
The Dark Energy does not add to Gravitation effects, since it does not warp space by its uniform spread and low density. Its main effect is in the expansion of space through creation of new nodes, and in the “virtual” particle creations due to fluctuations in its density. Since it is largely homogeneous and undifferentiated, it is imperceptible to our normal sensors.

The “Vacuum Catastrophe” of Quantum Mechanics at the dawn of the 21st Century mirrors the “Ultra-Violet Catastrophe” that gave birth to it in the first place at the dawn of the 20th. With the PL world, a simpler solution presents itself. Quantum Mechanics calculated the Vacuum Energy assuming Quantization of the vacuum, with harmonic oscillators producing a huge energy (10¹²⁰ times higher than measured value, “the worst theoretical prediction in the history of Physics”). String theory does no better, resorting ultimately to “Anthropic” principles and Landscape scenarios (“Last refuge of scoundrels”, says Krauss ☺) that create an “anything is possible” scenario and a Theory of Whatever (which, incidentally, because it uses unbroken supersymmetry (and therefore does not allow for a positive cosmological constant, massless scalar fields, or our actual particle set), includes “whatever” possible world you want, in a 10⁵⁰⁰ “landscape” or “discretuum”, EXCEPT our actual world!)). The “Vacuum Catastrophe” seems to have just given String theorists another opportunity to create another version of String Theory, theories that have been “growing exponentially as String theorists developed better techniques to construct them.” (Smolin ☺).

This is a true catastrophe, since “most of the physics that is observable at low energies seems to be governed by the vacuum (zero mode) structure and not by the microscopic theory, at least as far as we can see today.” (Lerche). The fact that nobody knows how to “calculate” this “Energy of Nothing” is a serious

problem for Physics. If only we had Nikola Tesla's mind, or at least his notes on this zero-point energy he espoused. At least Feynman had a funny answer: it is very small, "because it's empty" – "The vacuum doesn't weigh anything... because there's nothing there!". It is difficult to study because it is "meta-stable", as David Gross says, being the shaky ground reality is built on. Still, Lemaitre had anticipated this vacuum energy as far back as 1934.

What is wrong here is the assumption of Quantization and Harmonic oscillation – That property belongs to the Photon class, when PL density reaches a critical value and tension that starts the Electro-Magnetic cycle. At the steady state PL density, no such tension exists, no oscillations or quantization ensues, and the Vacuum energy is at the predicted level. The PL sea that creates the **Universal Vacuum** is the "perfect fluid" Lemaitre (and more recently Tipler) used to describe it and derive its equation of state with. Our observable world is the PLC clusters, while the "rest" is what we call the "Vacuum" or "Dark Energy", necessarily unobservable due to its low density, continuity and uniformity. This PL sea is what constitutes an emergent Euclidean 3-D space by providing lines in every possible direction – In this sense 3-D space and the "Zero-Point" Vacuum are identical. QM, which deals with the micro-world, is effective at the "nugget" energy levels of our Photon, which provides its quantization. Below that, its rules do not apply (the same way they conflict with general relativity, since they also assume a flat space-time background which does not always apply).

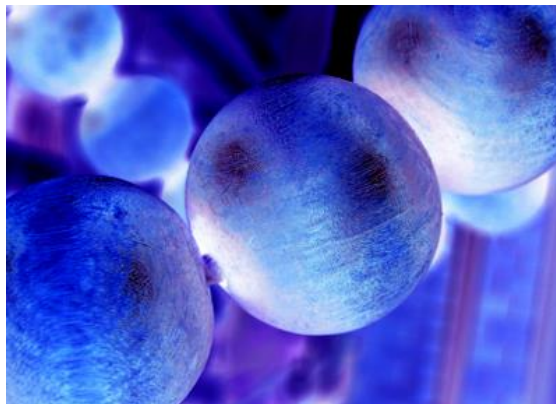


While the Vacuum is un-observable, is it existent, and it demonstrates its effects in the "expansion" and gravitational effects resultant from its "Space"

aspects. Since it creates nodes with single PLs, that align themselves with the existing mesh, it tends to create a “flat” Universe, counteracting any other tendencies of PLC clusters to warp the overall structure – and it is this “Flat” Universe that we see today to a great approximation.

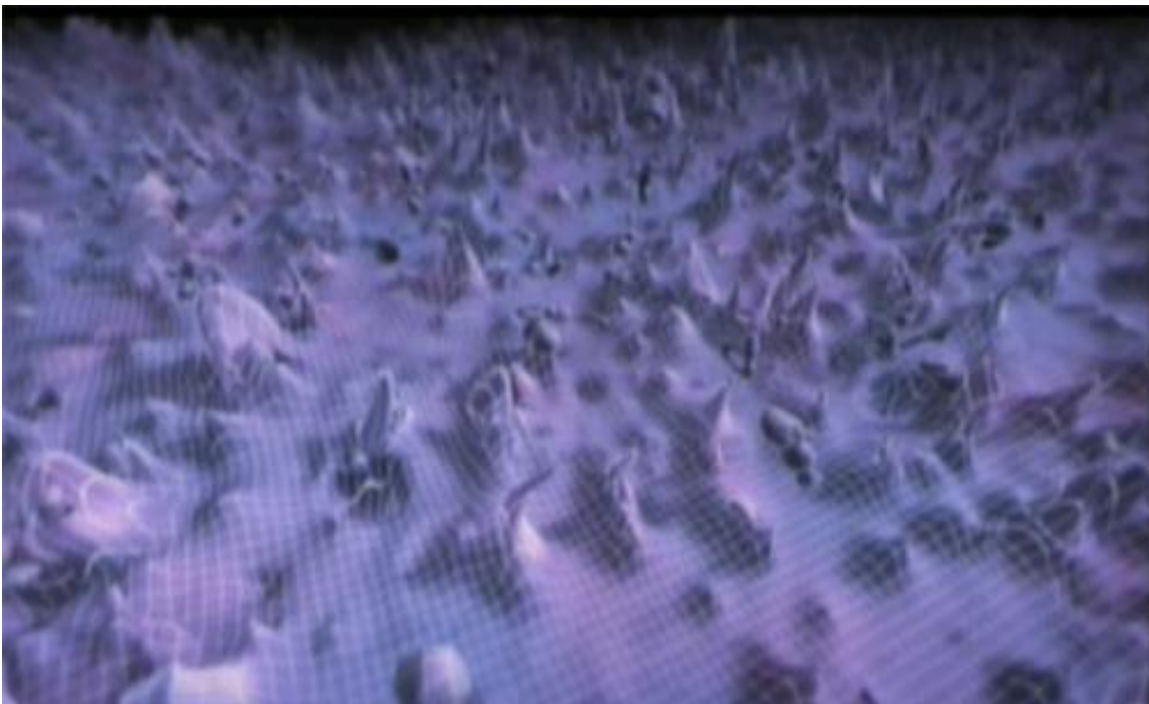
The growth in the number of PLs would logically be proportional to the existing volume of space, resulting in an accelerated expansion of the volume, and a flat universe picture reflecting a cosmological constant close to zero. McCrea and Narlikar had similar ideas early, with creation compensated by the negative pressure of their C-field.

The above points to an irony – The failure of QM on this “low energy”, small planck scale (normally associated with “high energy”), is parallel to the failure of Classical Mechanics on the Quantum (Photon – particle) scale. Each of the theories has a valid range of application- Classical for the macro-world, Quantum for the “Micro-world”, and PL-like theories on the sub-micro world. In fact, while QM handles matter quite well, the Photon is altogether a different story. By the Uncertainty Principle, the Photon, with its well defined Energy, has no definition in time, and by its well defined momentum, has no definition in space!! Even the mathematical formulation of QM has no Hermitian operator that straight-forwardly corresponds to position for Photons. Similarly, experiments indicate limits on the applicability of the concept of time both in the very small and in the very large, ignored by QM (I. E. Segal). Newton did not have to know QM or relativity to measure his apple’s (a large classical object’s) fall, and the fabric of spacetime (the extremely small) similarly does not have to know QM, which specializes in the micro-world atomic realm. The “notion of “shorter distances” will no longer make sense” (Seiberg) below the level addressed by QM, and further reductionalism will not apply.



The problem here is due to the fact that Photons, and hence PLs, DEFINE time and space, and hence their “location” and “time” do not come out of the equations, but create them. (Before and at the Big Bang, both space and time are ill defined, and “matter”, photons and even causality cannot exist). Once time and space emanates, QM can work with its corresponding by-products, such as quanta and particles. For Photons themselves, though, the concept of Length, time, etc must be treated very carefully, keeping the basic definitions in mind to avoid circularity and confusion. The idea that smaller size means higher energy fails once we cross the quantum limit (as we have seen earlier, with a limit on an oscillating EM wave) – the extrapolation does not continue. At the Planck length, PLs exist, in a non-Lorentzian framework, with low energy and FTL speeds, providing the space mesh & Dark Energy.

The “discovery” (questionable?) of the accelerated expansion of the Universe, the abundance of “Dark Energy”, was a shocking discovery at the close of the last Century. It hinted at a major re-examination of our concepts of “empty space” and the structure of Space and Time, something Quantum Mechanics and String Theory had failed to provide (Krauss jokes that String Theory does for observational cosmology what it has thus far done for experimental elementary particle physics: namely, nothing ☺). A PL Fluid picture paints the simplest explanation of this phenomenon at the Planck level, the space-time foam level, where QM, relativity and our other theories do not apply.



Wilczek has a proposal for a potential role for an axion-variant, a weakly interacting particle he calls the **cosmion**, which can simulate the currently observed non-vanishing (but small) cosmological constant. It is a very light particle ($\ll 10^{-60}$ Mplanck), that will fix the asymptotic value of the cosmological constant at zero, and explain the Dark Energy. Sounds very much like our PL particle! Of course Wiczek does this the hard way ☺, using Peccei-Quinn symmetry breaking & R-Parity, which creates a scalar field that produces those axions. He also sees the same axion field, depending on its density, explaining Dark Matter, as our PL proposal does. More so, he recognizes that the field can be regarded as a gas of non-relativistic particles (in a coherent state)!

Tipler argues for even the CMBR radiation to be not an EM field, but an SU(2) field, which he uses to explain the cosmological constant, the horizon problem, and other cosmological issues. His proposal for Dark Matter is a Z-particle-like entity, the Z particle known for its weak interaction with matter. The point in all of this is that the PL formations can take multiple configurations other than the EM and Color “radiation”, depending on the PL density and evolution. Those formations would still reside in the EM and Color dimensions, but have different apparent properties based on the symmetry rules they obey. The presence of the PLs can then impact the “Energy content” of the Universe without being otherwise detected as EM or Color “energy” we are used to.

One hint towards our PLs being the basis of the Dark Energy: our heuristic calculation of number of PLs in a Photon (see Appendix) say it contains of the order 10^{90+} PLs. That would mean a PL sheet would have a density of 10^{90-} less than a “Photon” sheet, which might start explaining the 10^{120} error in vacuum energy calculations, and get us closer to Wilczek’s cosmions. It meets the understanding of the vacuum as being the state of lowest energy – the PL. It avoids the huge calculation mismatch, because the mismatch assumes an oscillating radiation, which only applies to photons, not PLs.

The Vacuum, not necessarily the Quantum Vacuum, is not the space between things. It is the sheet the Universe is written on, the plane of existence. Particles stand on it, waves roll on it, and their interactions define our world. It is a sea of potentiality, where existence emerges and submerges again out of the logical chaos. Matter comes out of the “Space-time” foam, as strings or

loops in spacetime, a pure geometrical construction, with nothing else behind it. The shape of the matter and energy changes over the cosmic epochs (black holes at the singularity, GUT matter and eventually leptons and baryons as the various symmetries break), but it all plays out on the geometry over the vacuum sheet. As Mario Livio says, “The simplest (though in some ways, most mysterious) possibility is that (Dark Energy) is a form of energy embodied in space itself, even when otherwise empty”. The cells that harbor this energy (our PLs) are beyond our experimental reach, as trying to “see” them with high-energy probes just creates more of them! Smolin’s Loop Gravity threads them via Spin Networks to create space.

When we “say” gravitational energy of a black hole is converted into particle pair production, we mean that part of the geometry of the black hole unfolds into the geometry of the particle pairs. We can only talk this way now, because the expanding Universe has made the Vacuum Sheet large enough, for the matter formations to look like distinct blips on it – Space-time seems distinct from matter and radiation. At Creation, the tightly confounded warp could not distinguish those blips- and hence the perfect Symmetry at that “Energy Level”. When the GUT symmetry breaks, we can say mass and space-time separate, and the “energy” (read: previous high warp before GUT Symmetry breaking) is used to create particles (read: unfolds into smaller particle warps). The remaining “energy” (warp) also unwound itself via the expansion of the vacuum sheet (space-time), leading to the inflationary expansion, which carried the particles along with it.

The Ether – you can call it the Grid – is there. Einstein recanted: “More careful reflection teaches us, however, that the special theory of relativity does not compel us to deny ether.” “There can be no space nor any part of space without gravitational potentials, ... The existence of the gravitational field is inseparably bound up with the existence of space.”

According to Wilczek (my new favorite after Einstein, Feynman and Bell, being a “visual” genius like them): “It seems to be spread evenly, with the same density everywhere and everywhen, as if it were an intrinsic property of space-time.” Of course it is, since it *is* space-time. “Its density is only about 7×10^{-30} times the density of water.” Hence our PL Fluid world model.

Quintessence & “phantom energy” theories currently being bandied may simulate the effect of the Dark Energy PL game- but Occam’s razor would

swiftly cut them out. “We may find out that the dark energy vanishes in a puff of logic when we rid our mathematics of certain assumptions...” (Michael Brooks). The Dark Energy, the source of the “Cosmological Constant” of the Field Equations of General Relativity, Einstein’s Biggest Blunder trying to balance the Universe and resolve Bentley’s Paradox (which turned out to be not so blunderly – we should all blunder so; as Michael Turner of Fermilab said: “What was good enough for Einstein, ought to be good enough for us”), continues to confound, even as the fate of the Universe hangs in the balance.

“Mathematically the deep reason for the infinities is that space and time are assumed in quantum field theory to be continuous.... It is reminiscent of the ultraviolet catastrophe that plagued blackbody theory before Planck. This is why the notion of making space and time discrete occurred naturally to Heisenberg.” – Kent Peacock



“This is the way the world ends. Not with a bang but a whimper.” - T. S. Elliot

“Some say the world will end in fire, Some say in ice” - Robert Frost

Takeaway: The Ether mesh of PLs has the energy of the PLs that shape it. This is the Dark Energy that forms Space, and by its ongoing creation process, expands space.

14 - EPILOGUE

"Theories have four stages of acceptance:

- i. This is worthless nonsense;*
- ii. This is interesting, but perverse;*
- iii. This is true, but quite unimportant;*
- iv. I always said so."*

J.B.S. Haldane

"If you're working on something new, then you are necessarily an amateur."

– John Wheeler

"... the end of our exploring

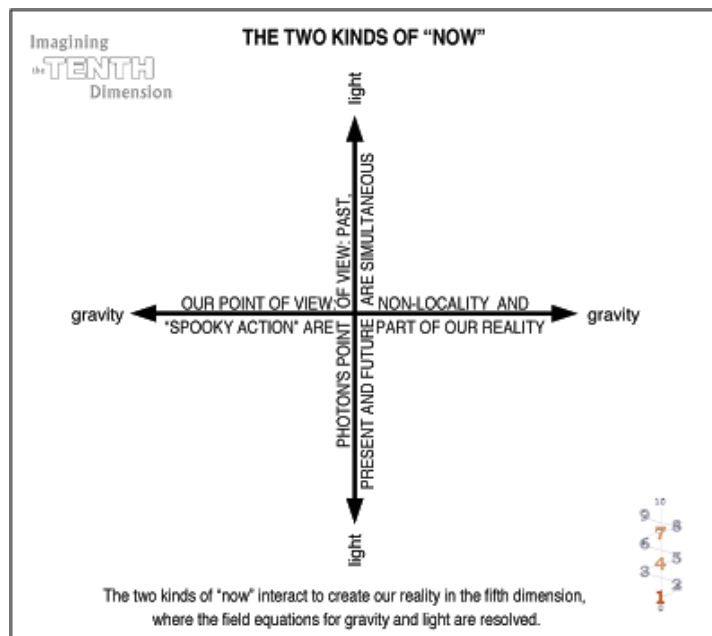
Will be to arrive where we started

And know the place for the first time." – T.S. Elliot

In a world where Relativity and Quantum Mechanics are solidly verifiable facts, we have to admit two things:

- Our concept of time needs to change
- Our concept of Space needs to change

If relativity says that a photon does not see time pass, and if Quantum mechanics says that entangled photons ignore distance and space, and if we are apparently made out of photons/Energy, then neither time nor space should matter to us. But they do, and hence the enigma and the challenge.



We have here proposed a possible visual picture that could start to explain how this Alice in Wonderland scenario could unfold. We tried to fold into it as many of the known theoretical and experimental issues to see if they fit, and lack of mathematical rigor notwithstanding, a “first-cut” glance gives it a pass. It is a tossed salad of many existing ideas, combining features of Loop Quantum Gravity with a Superfluid (BEC) Universe, with hints of Strings & Twistor theory, while assuming SR, GR and QM as givens in their respective domains. It adopts Relativity’s view of a world of “events” that define our concept of space & time, embedded in a digital, logical background sea that is the “matter” primordial – the world as information evolved and structured from the void. It is a connected world, non-local in essence, with locality an emergent, approximate feature of the macroworld it generates.



The idea grows from listening to Nature’s cues and clues. Nature is not “malicious”, to quote Einstein, and has been hinting to us in many ways as we thrash around in search for a Theory of Everything:

- It is telling us its Vacuum is similar to our Superfluids, as He3 simulations and models clearly show.
- It shows us Phonons that are almost exact parallels of the more mysterious photons, allowing us to study a replica.
- It repeatedly shows energy conversion to matter/anti-matter pairs, and vice versa, hinting at the content of matter and its structure.
- Its equations for EM and Gravity cry out for an analogy, showing geometry in action.

- Its hierarchy repeating at all scales, from atomic orbits to Solar orbits to Galactic orbits, points the way to similar structures underneath.
- Its discrete manifestations in QM hint at its discrete infrastructure, and its “informational” underpinnings.

It is not a rigorous concept, but it could serve to guide one. It is a new paradigm as stated, but it is also a paradigm that has been digested in different forms for ages by scientists and philosophers, and would not cause a “Kuhnian” revolution. And as my role-model common-sense scientist John Bell advised: “Always test your general reasoning against simple models”, the concept passes the first test. The next test would be to heed John’s advice: “The problem then would be to do this with clean mathematics, and not just talk”. The Helium Superfluid analogies lead me to believe that task too should succeed.

Maybe we “know too much”, like the older Pauli, to venture new bold proposals. Maybe, as Skovoroda hoped, God “created the world in such a way that everything simple is true and everything complicated is untrue”. Few people know that the solution of Olber’s paradox, which stymied scientists for generations, was first discovered by a mystery writer, Edgar Allen Poe – “that the distance of the invisible background is so immense that no rays from it has yet been able to reach us at all.” (He was also the first, incidentally, to predict the Big Bang!). He found the idea “is by far too beautiful not to possess truth as its essentiality.” As Linde says: “I just had the feeling that it was impossible for God not to use such a good possibility to simplify his work.” I feel this idea has the same ring of beauty and truth.

They say “Ignorance is Bliss”, and Eden was a Blissful place. I am glad we have been banished from the ignorance of Eden. Let us move forward to find the truth out there.

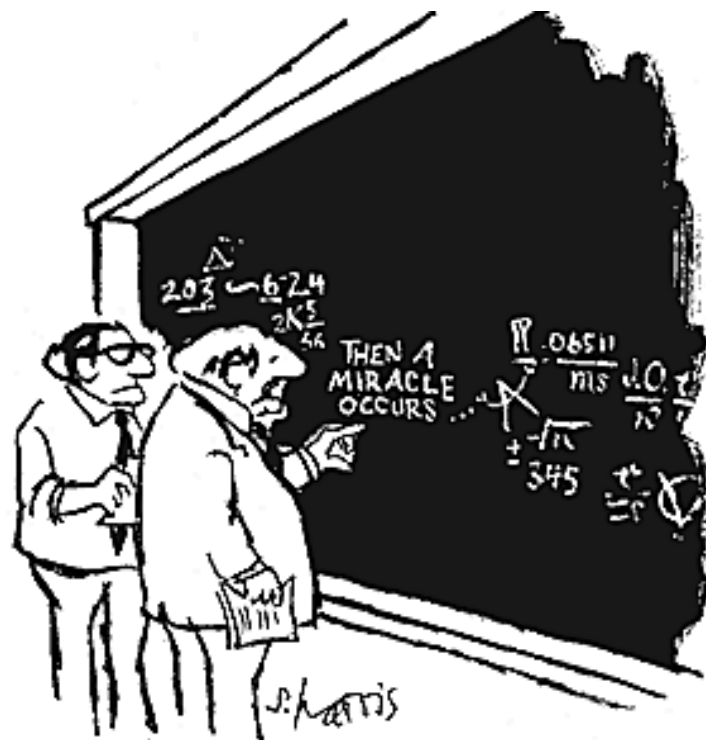


"If experiments contradict a beautiful idea, let us forget about experiments" – Chen Nin Yang

"Quantum Mechanics describes Nature as absurd from the point of view of common sense. And it fully agrees with experiment. So I hope you can accept Nature as She is – Absurd!" – Richard Feynman

"If you have had your attention directed to the novelties of thought in your own lifetime, you will have observed that almost all really new ideas have a certain aspect of foolishness when they are first produced." – Alfred North Whitehead

"No great Discovery was ever made without a bold guess." – Isaac Newton



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

"Im Abgrung wohnt die Wahrheit." – The Truth lies in the Abyss - Schiller

"The more 'crazy' an idea is, the more profound it becomes when it turns out to be relevant in the description of natural phenomena" – Chen Nin Yang

"We may be convinced that it [the universal formula] will have the form of an extremal principle, not because nature has a will or purpose or economy, but because the mechanism of our thinking has no other way of condensing a complicated structure of laws into a short expression". – Born

14.1 - PREDICTIONS

“Hypothesis non fingo” - Isaac Newton

As both Niels Bohr and our Great New York Philosopher Yogi would say, Prediction is hard, especially when it is about the future.

So, first a retrodiction: If the space matrix expansion is due to the spontaneous creation of PL nodes from the Nil-Source, it would be reasonable to expect this to be a uniform function of the space matrix, the increase in nodes proportional to the space nodes currently in place. This would make for an accelerated rate of expansion, with a Cosmological constant close to 1, which is what we see as a very good approximation today. An inflationary period would result from the initial high density PLC at the Singularity.

A few predictions:

- **If** the Pilot Waves are emissions from the particles, then for Photons floating in low density open space, this would result in an inexorable slow loss in “Energy”, the Tired Light hypothesis. Light travelling from Stars billions of light years away would lose energy to space, and its frequency would decrease, resulting in a higher Red-Shift observed. This would mean the observed “acceleration” of expansion is miscalculated (the data is murky at best) - Space expansion is accelerating (driven by the low density PL creation in the vacuum expanding space), but the loss of energy shows up as a higher Redshift, further biasing the data observed. We should be able to calculate the loss rate based on those observations. (The Doppler shift due to space expansion is problematic at best for Light, the sound/air wave analogy not pertinent due to the fixed speed of light – the red-shifted light effectively losing energy to where??). Once considered, the future of the Universe, to paraphrase Yogi Berra, is not what it used to be.
- There is a Lower limit of the frequency of Light, below which the sinusoidal wave structure would not hold, and the flow properties of space and the PL Fluid would turn the Energy flow into a “Dark Matter” or “Dark Energy” mode. Potential experiments may allow us to see this hypothetical boundary in action, and perhaps illuminate the PL world-picture.

- There is a Higher limit on the frequency of light, when we hit the shortest length oscillating photon, after which the energy of the photon is delivered non-linearly in a single nugget and not a wave. Look for the speed of light to vary after that limit.

In guarding against optimism and false predictions, I would like to quote Thomas C. Chamberlain, professor of Geology at the University of Chicago in 1899, challenging the predominant view and predictions of a short age of the Universe (vigorously expounded by no less than Lord Kelvin, the pre-eminent Physicist of his time, based on his “estimates” of the heat content & cooling rates of the Earth and Sun):

“Is present knowledge relative to the behavior of matter under such extraordinary conditions as obtained in the interior of the sun sufficiently exhaustive to warrant the assertion that no recognized sources of heat reside there? What the internal constitution of atoms may be is yet open to question. It is not improbable that they are complex organizations and seats of enormous energies. Certainly no careful chemist would affirm either that the atoms are really elementary or that there may not be locked up in them energies of the first order of magnitude. No cautious chemist would probably venture to assert that the component atomcules, to use a convenient phrase, may not have energies of rotation, revolution, position, and be otherwise comparable in kind and proportion of the planetary system. Nor would they probably be prepared to affirm or deny that the extraordinary conditions which reside at the center of the Sun may not set free a portion of this energy.”

The next 30 years vindicated the geologist with a vengeance, and proved the pre-eminent physicist wrong. Perhaps keeping an open mind is the best science, for maybe a geologist or a chemist or a mathematician (or just a simple educated lay-man 😊!) may hold the keys to unlocking the physics of the future.

“Something is wrong with Science – fundamentally wrong. Theories keep getting stranger and stranger.” - T. Van Flandern

***“This balancing on the dizzying path between genius and madness is awful”
- Einstein (on Dirac)***

“Most Physicists believe that, had they been around at the birth of relativity, they would have been able to instantly appreciate its radical elements. But my own experience indicates that if Einstein were to send his paper to Physical Review today it would have almost no chance at all of being published. “Highly Speculative!” would be the referee report, a death shell to any paper. He would have to append it to an article on string theory, or some other fad, and hope it wasn’t noticed.”

- Daniel Greenberger

“No non-poetic account of reality can be complete” – John Myhill

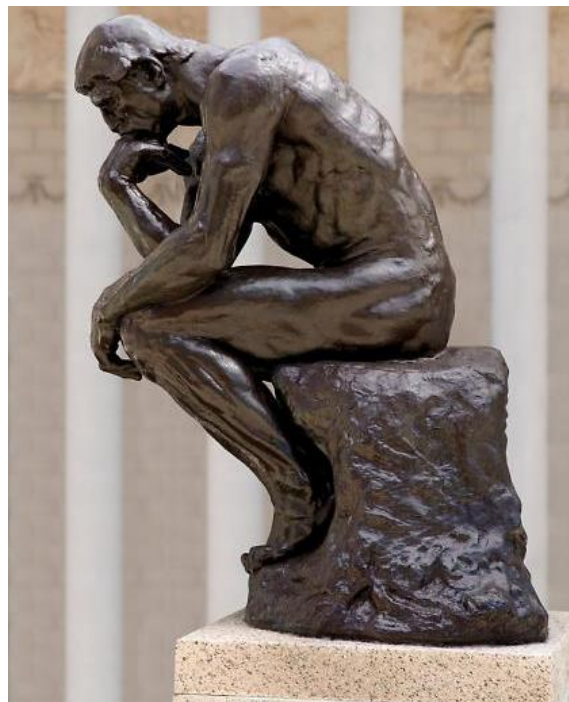
A few thoughts on intelligent life.

If intelligent life is an emergent feature of our world, a complexity resulting from the manifold correlations of the “particles” and “energy” in this world, then those correlations also exist in the Netherworld whence our world emerges.

So when those correlations fail in our world (read Die), does anything remain of those correlations in the Netherworld? Does the “negative” copy of our Mind persist in that world, to possibly re-emerge when conditions allow in another Hilbert Space appearance when circumstances allow?

The first guess would be NO. Since the two worlds are intricately correlated, decoherence in this world would lead to decoherence in the other.

But then we scarcely understand the makings of the Mind. It takes a lot of matter to make up a Mind, and a lot of atoms and energy to make a bit of information. Perhaps that matter is not all necessary for the bit, and its decoherence, while deconstructing the “presentation” in this World of the information, may not deconstruct the information in the Netherworld.



And if this world emanates from Logic, distributed throughout a “virtual” reality that grows and interacts, then is this Digital Universe a “Computer” of sorts? Is its inexorable expression a built-in program, “self” generated and “self-expressed”, infinite in Magnitude and enormous in Power? And is it not inevitable from the logic of Chaos? This self-generated, infinite, powerful entity... sound familiar from Sunday School? “God is *being-itself*, not *a* being”, says Paul Tillich.

And since that world is highly correlated, leading to entanglement and non-local phenomena, couldn't all this correlated information also form a part of a multiplex of intelligence that continues to drive the formation of others, and drives “creation” in the direction of intelligent life? Could that super-complex, in its Unity, represent the One, the Intelligence that drives the Universe?

On a different plane: what if we were able to decipher the PL entanglements and rules in their basic form, and eventually be able to control them? Would we be able to “travel” to other Hilbert Clusters, other worlds now unreachable? Are these the wormholes that open up when we concentrate energy at the planck length? Would we zip across the Universe and unchain ourselves from our material speed limit? *Should* we (in our current immature state)?

A quick word on musings, and Eastern Philosophy. It is important to wonder, philosophize and think out of the box. It is also useful to acquaint oneself with other world views and perspectives. I have often quoted excerpts from Eastern Philosophy as potential echoes of modern ideas, reflecting a sort of “Tao of Physics”. But I want to make sure it is clear that I view Western Science (which was enriched in earlier times, and again recently, by Eastern Science) is a much more powerful tool than Enlightenment rhapsodies. It is one thing to say that entanglement reminds one of the Unity preached by Eastern thought. But we got to Entanglement by thousands of hard earned experiments, hundreds of detailed proposals, and hard facts. What we ended up with allowed us, in addition to understanding the basics of Nature, to build GPS systems, computers, advanced chemicals, medicines, and other amazing technologies that have had a material impact on people's lives, improving them immeasurably. The status on a worldmap immediately reflects that impact. No Guru or Sophists can claim equivalent benefit to the world – their quasi-scientific comparisons are but “the shadow of an analogy”, as John Bell told the Maharishi. Western Science coordinates large areas of knowledge and

experience into testable theories and laws, slowly building an edifice and a foundation from which philosophy can rhapsodize while staying in tune with reality. When a physicist turns to mysticism to explain what he is seeing, it signals a surrender and an end to his or her active contribution. His musings may inspire others to new ways of seeking the answers, but they do not provide explicit answers in themselves. To paraphrase an old doozy: when the Guru wants to meet his disciples in California, he takes a Boeing 747, not a magic carpet.

There are more wonders in this world than is dreamt of in our Philosophy - (William).

So much to do, so little Time.



42

“Share and Enjoy”

“There is a theory which states that if ever anyone discovers exactly what the Universe is for and why it is here, it will instantly disappear and be replaced by something even more bizarrely inexplicable.”

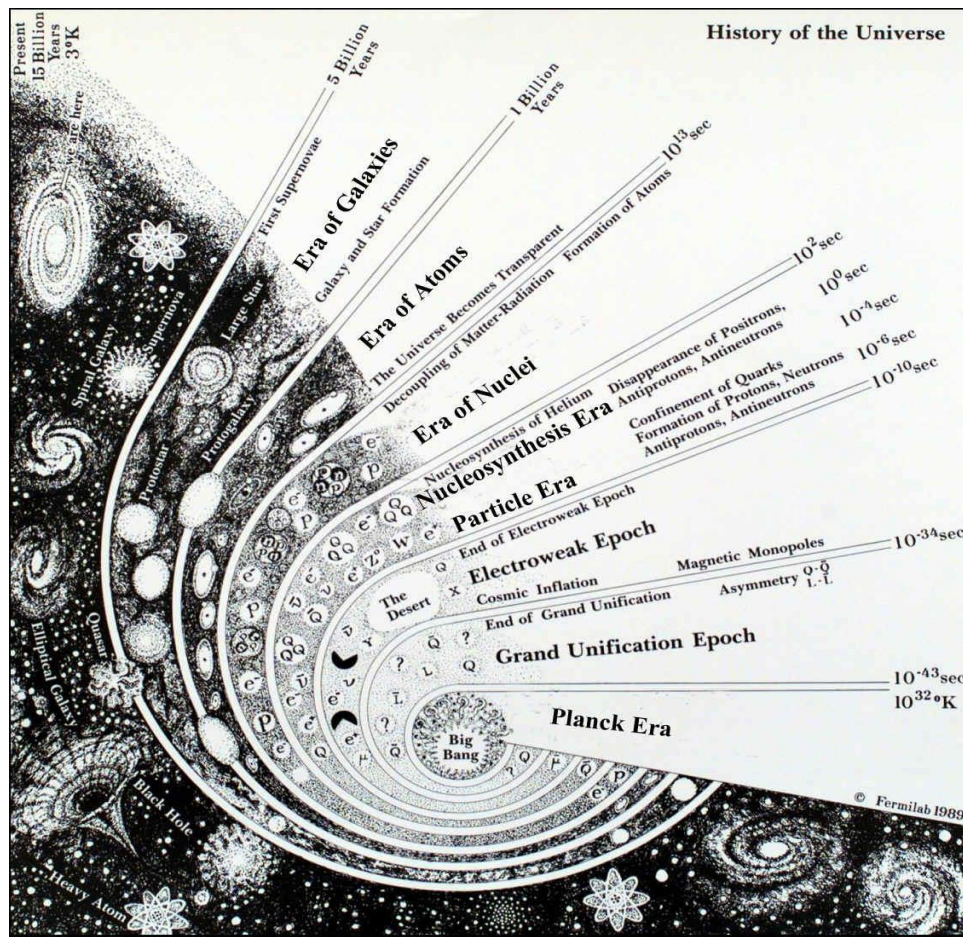


DON'T PANIC!

14.3 - UNIFICATION

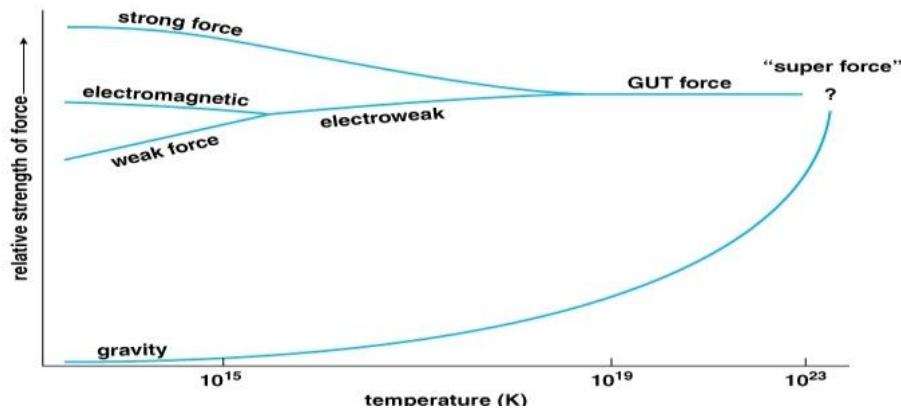
My GUT tells me we may have a track to Unification in the PL Story.

- With time, mass, charge, gravity, relativity, and “energy” emergent from this concept of a “PL Space”, and “Force” concepts clarified as geometric effects, we have a new Wheeler & Misner “already-unified” theory based on a single logical concept for the creation of “Existence”.
- With the basic concepts in place, our current standard models for particle physics and cosmology do a lot of the explaining at a macro level from the Planck era to the distant future.



- The Key to the workings of this model is the concept of Entanglement (an observed effect) in the hidden “Nether-World” of the Nil-Source. The continued correlations of “separated” particle in the plane of “reality” via their algorithms in the Netherworld source, and the PL Pilot link with its source wave, explain EPR and the matter/wave duality.

- The Algorithms for the interactions of the nodes in the Hilbert Space of Existence need to be worked out, and we have Gas ThermoDynamics and HydroDynamics as a starting point. The configurations of the particle clusters also need to be worked out, taking a clue from cluster formations in our macro world, with modeling an essential tool.



The union of the four forces at higher energies may point to a “saturation” effect in the additional dimensions which represent the “charges” driving those forces. If we see Charge, and Gravity, as “warps” in space, protrusions into the additional dimensions, then at very high “energies” (PL densities) saturation of the dimensions would lead to similar effects – a kind of “flattening” of those dimensions and higher symmetry for all types of interactions – Unification. When EM Waves reach their maximum energy in a wave form, their non-linear nuggets start to go into other dimensions and unify with the weak and the strong Force. “Lightweight, with no measurable size, the up and down quarks take on characteristics of leptons, which in the proton and neutron as a whole are hidden. The similarities are so marked that it is as if a quark is a lepton that has been “painted” with any of three colors, electrical charge also being fractionated three ways. That this is the case seems clear; how it is done is not” (F. Close). Unification is around us, and does not need the whole world to be at a high energy level- just the EM nuggets.

Unification points to the need for new ideas. Classical physics worked fine at our “human” scales, and Newton’s laws and Maxwell’s equations served their purpose well in that arena. When we stretched the limits to higher speeds, we needed relativity, and when we stretched the limits to the microworld, we needed QM. But now we are stretching the limits to the Planck scale, and to

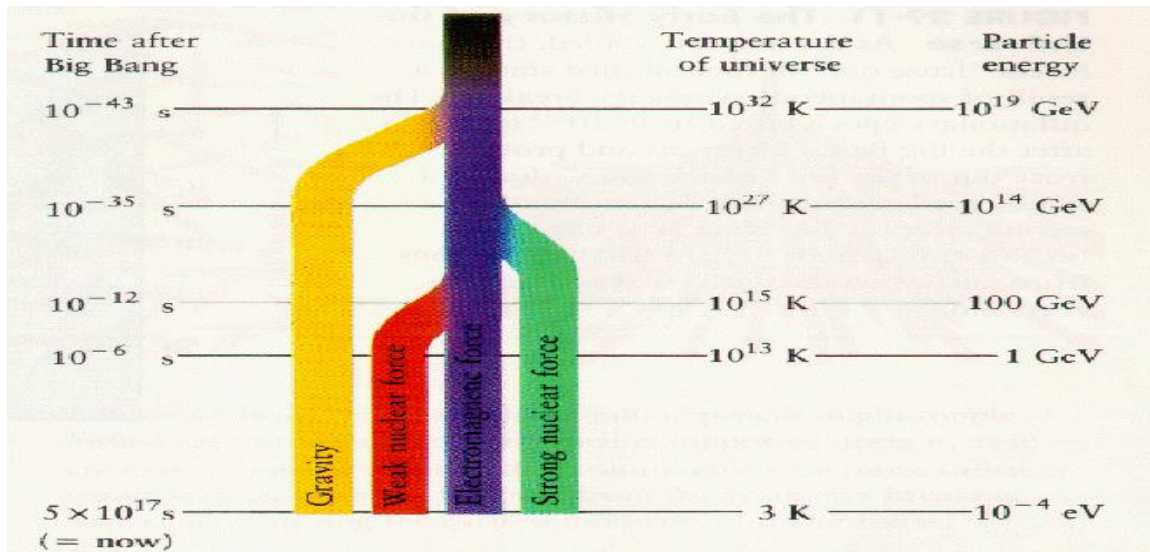
the Universal scales. This large jump again requires a new perspective, a new Physics, and perhaps a PL world is that perspective.

However, one may also find that “the other side of the coin is that the “Theory of Everything” fails to describe the low-energy physics just because of the enormous degrees of freedom. In such cases the low energy physics cannot be derived from first principles without extensive numerical simulations, while the effective theory [like QM and Standard Model] operating with the restricted number of soft variables can incorporate the most important phenomena of the low-energy physics, which sometimes are too exotic (the quantum Hall effect (QHE) is an example) to be predicted by “The Theory of Everything”” (Laughlin & Pines). In other words, it is easier to describe a baseball game using ball and bat, than to describe the multitude of atoms constituting them and their shenanigans. “Thus we must choose between the uncomfortable life of microscopic physics without paradoxes, and the comfortable life of the effective theory with its un-avoidable paradoxes” (Volovik). Schwinger thought “we need a more flexible kind of theory, one that can incorporate experimental results, and extrapolate them in a reasonable manner without falling into the trap of the wholesale extrapolation that infringes on unexplored areas where surprises are sure to await”, renormalization being one such “process of transferring attention from the underlying dynamical variables with which the theory begins to the physical level at which the observed particles are in evidence”, and allowing “solutions – finite solutions, with numerical consequences that are in overwhelming agreement with experiment”. Such equations “only make use of physics that is reasonably well established. In contrast, the unrenormalized equations critically involve phenomena in regions where we cannot pretend to know the physics”, and whose description “constitutes a model of the dynamical structure of the physical particles, which is sensitive to details at distances where we have no particular reason to believe in the correctness of the physics – an implicit speculation about inner structure – while the renormalized description removes these unwarranted speculations...”.

We propose an approach that does not require us to give in too early, as Schwinger proposes.

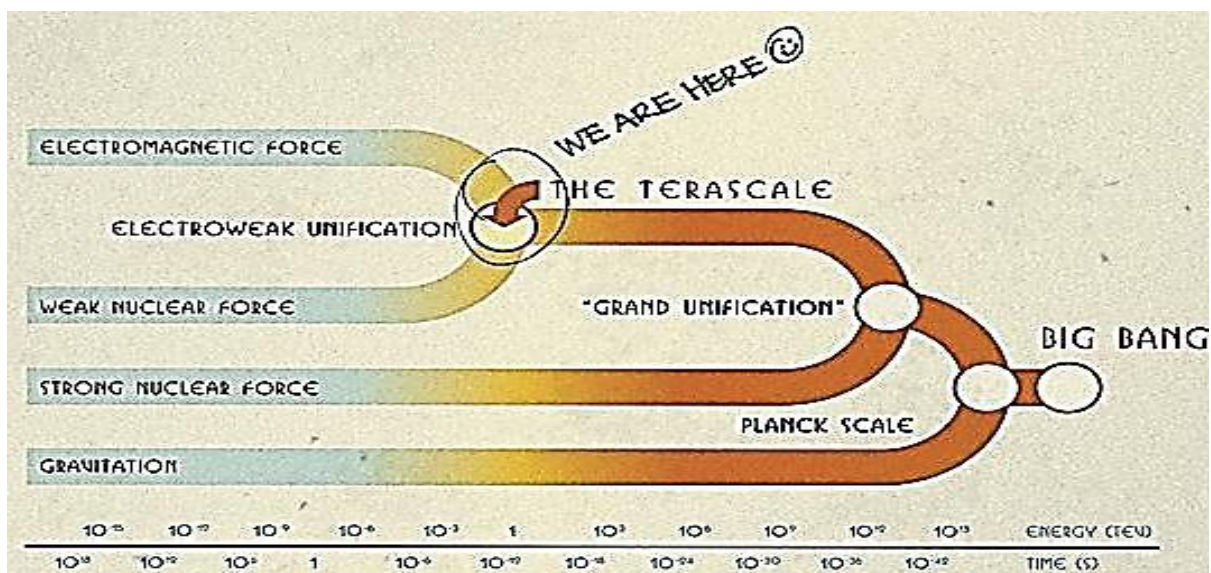
“Only those who attempt the absurd will achieve the impossible”

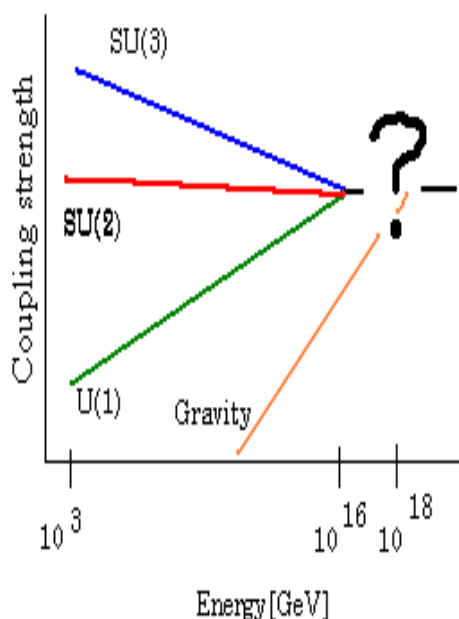
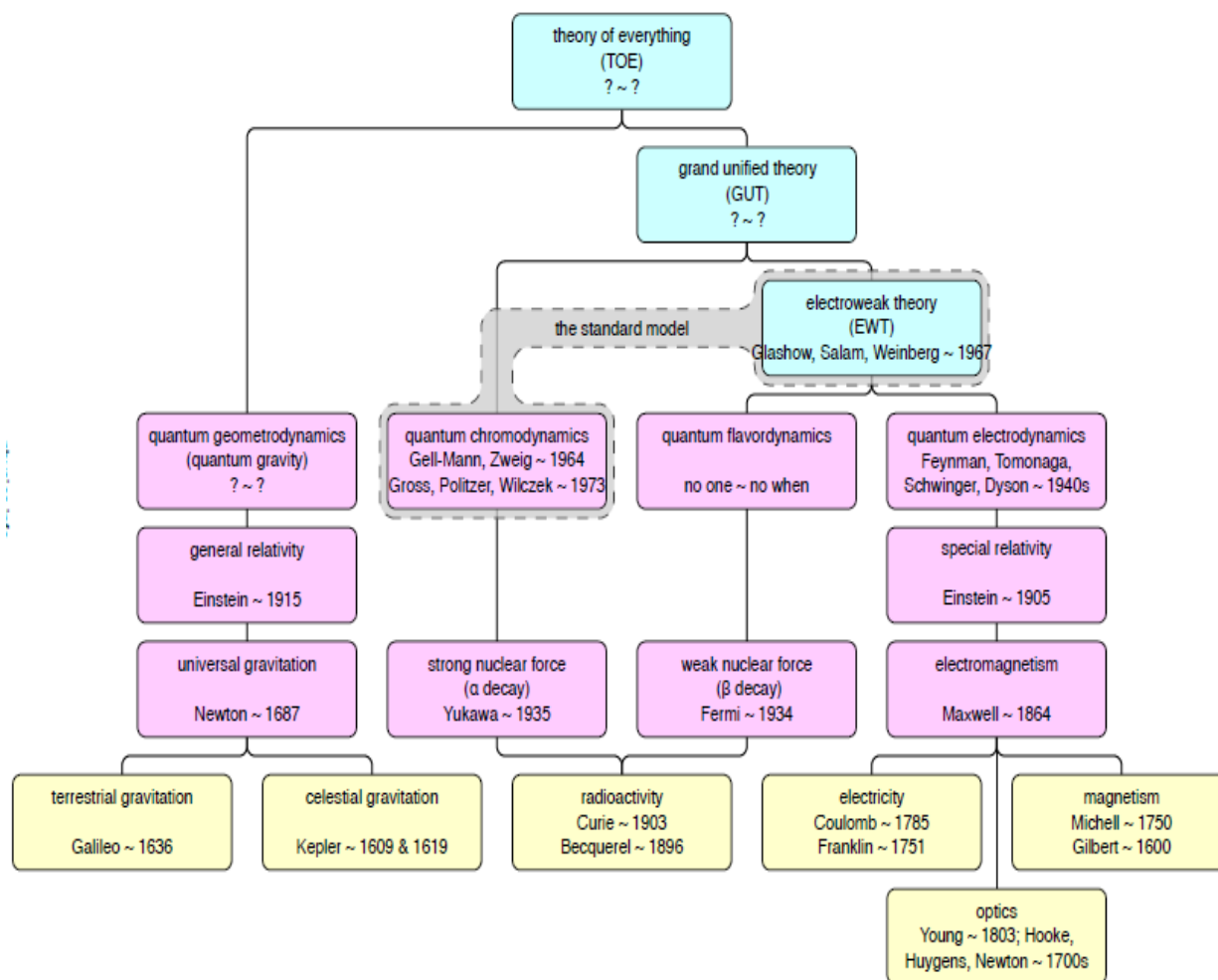
- M. C. Escher



"If we supposed that theories gave true knowledge, corresponding to 'reality as it is', then we would have to conclude that Newtonian Mechanics was true until around 1900, after which it suddenly became false, while relativity and quantum theory suddenly became the truth. Such an absurd conclusion does not arise, however, if we say that all theories are insights, which are neither true nor false... Man is continually developing new forms of insight, which are clear up to a point and then tend to become unclear. In this activity, there is evidently no reason to suppose that there is or will be a final form of insight (corresponding to absolute truth) or even a steady series of approximations to this. Rather, one may expect the unending development of new forms of insight (which will, however assimilate certain key features of the older forms as simplifications, in the way that relativity theory does with Newtonian theory). Our theories are to be regarded primarily as ways of looking at the world as a whole ('world-views') rather than as 'absolute true knowledge of how things are'".

- David Bohm, "Wholeness and the Implicate Order", 1980





Unification of Forces

Strong	Electromagnetic	Weak	Gravity
hadrons: p, n ; pions: π^{\pm}, π^0 ; (QCD: quarks, gluons)	charged particles: e^{-}, μ^{-}, τ^{-} ; $p; \pi^{\pm}$	$p, n, \pi; e, \mu, \tau$; neutrinos: $\nu_e, \nu_{\mu}, \nu_{\tau}$	all particles (always attractive)
nuclear binding; energy in stars	atoms, crystals, molecules; light; chemical energy	decays: $n \rightarrow$ $p e^{-} \bar{\nu}_e$; element synthesis	weight; binding of solar system, stars, galaxies
	$\leftarrow E + B \rightarrow$ (Maxwell)		
\leftarrow QCD \rightarrow	\leftarrow Electroweak ($SU(2) \times U(1)$) \rightarrow		
\leftarrow Grand Unification (GUT)? \rightarrow			
\leftarrow Superstring? \rightarrow			

THEORIES OF EVERYTHING

In the quest for an ultimate theory of the universe, there is now a bevy of alternatives to string theory. These seek to develop models of space-time and gravity on a quantum scale

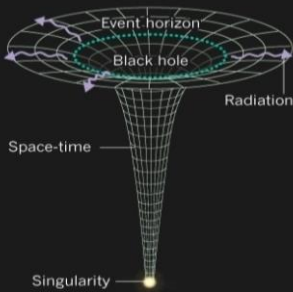
ALTERNATIVE THEORY	LOOP QUANTUM GRAVITY	CAUSAL DYNAMICAL TRIANGULATIONS	QUANTUM EINSTEIN GRAVITY	QUANTUM GRAPHITY	INTERNAL RELATIVITY
KEY POINT	Space-time has a discrete, loopy structure at the quantum scale	Space-time is divided into tiny building blocks joined according to quantum mechanics	At the quantum scale, gravity attains a fixed strength and space-time is fractal	Space-time emerges when a network of nodes undergoes a phase transition	General relativity may emerge from a quantum phase transition
WHY IT'S INTERESTING	Might tell us what happened before the big bang	Enforcing causality yields three dimensions of space and one of time at large scales	Unlike in relativity, gravity does not blow up at small scales	May provide an alternative to the inflationary model of the early universe	May be able to derive a correct value for the cosmological constant
REMAINING PROBLEM	Doesn't replicate our own space-time at large scales	Needs to make testable predictions	Proving that gravity's strength becomes fixed	Details of how space-time emerges remain unclear	Theory still needs to be fleshed out

THE FABRIC OF REALITY

If space and time are not fundamental, then what is? Theoretical physicists are exploring several possible answers.

One clue

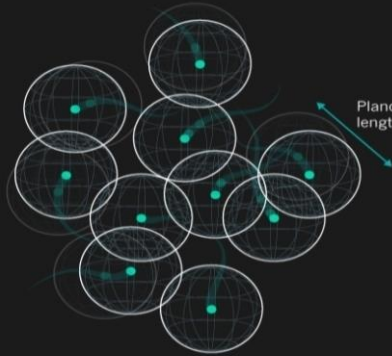
Quantum effects in the gravitational field of a black hole cause it to radiate energy as if it were hot, implying a deep connection between quantum theory, gravity and thermodynamics — the science of heat.



The black hole's mass is concentrated at a singularity of infinite curvature.

1. Gravity as thermodynamics

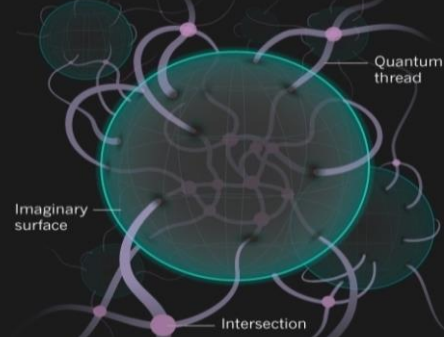
The equations of gravity can actually be derived from thermodynamics, without reference to space-time curvature.



This suggests that gravity on a macroscopic scale is just an average of the behaviour of some still-unknown 'atoms' of space-time.

2. Loop quantum gravity

The Universe is a network of intersecting quantum threads, each of which carries quantum information about the size and shape of nearby space.

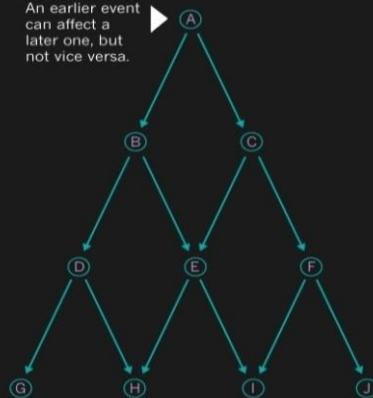


Imagine drawing a closed surface anywhere in the network. Its volume is determined by the intersections it encloses; its area by the number of threads that pierce it.

3. Causal sets

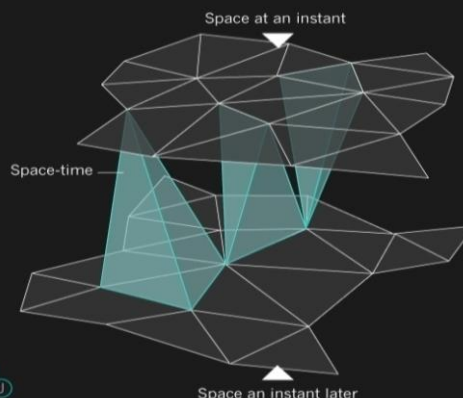
The building blocks of space-time are point-like 'events' that form an ever-expanding network linked by causality.

An earlier event can affect a later one, but not vice versa.



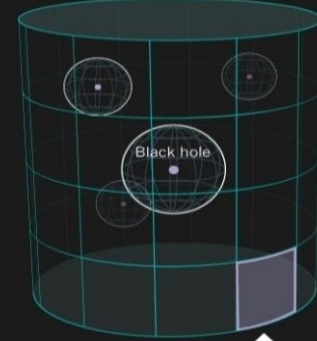
4. Causal dynamical triangulations

Computer simulations approximate the fundamental quantum reality as tiny polygonal shapes, which obey quantum rules as they spontaneously self-assemble into larger patches of space-time.



5. Holography

A three-dimensional (3D) universe contains black holes and strings governed solely by gravity, whereas its 2D boundary contains ordinary particles governed solely by standard quantum-field theory.



Anything happening in the 3D interior can be described as a process on the 2D boundary, and vice versa.

“The unfortunate soul who had literally seen the light would, when dragged back into the (Plato’s) cave, appear at first to his former compatriots to be a lunatic. This does not, however, mean that all lunatics have seen the light.” ☺

- Lawrence Krauss, “Hiding in the Mirror”

The proposal described above is a sketch of a possible scenario for the raw makings of creation. A rough sketch, admittedly, but a possible starting point for a more comprehensive analysis. Taken “cum grano salis”, it could form a basis for visualizing the root foundations of Quantum-Mechanics, Relativity, and the Standard Model, the current foundations of our Physical knowledge.

If the model proves plausible and coherent, it would need the refining hands of mathematical rigor to make it useful. It will also definitely change form repeatedly as all new principles have. Theories are not static, but build on each other and may trans-mogrify repeatedly before reaching maturity. Einstein’s relativity purports to lead to 4-dimensional Space-Time, but that concept was really Minkowski’s, a few years after Einstein’s Miracle Year- Minkowski clarifying what his “lazy” student had enunciated. Quantum Mechanics, an initial lucky guess by Planck, a rigorous effort by Einstein, expanded by Bohr’s atom, ended up being an unrecognizable puzzle that Einstein eventually disapproved of. Gell-Mann, the Quark Meister, did not believe his brainchild was real, even walking out on Dalitz who thought he had the proof, until Bjorken forced a proof, convincing him & Feynman (who had his own similar “parton” model). As was well said by Herodotus of Ephesus 2500 years ago, “Physis Kryptesthai Philei”- Nature Loves to hide.

Of course, far be it from me to compare with such luminaries – I have not, as Einstein said, “Earned the right to a few mistakes”. After all, as Landenburg said, “There are two kinds of Physicists in Berlin: on the one hand was Einstein, and on the other all the rest.” I am not even one of the “rest”, and like Gauss said, do fear the “Clamor of the Boeothians”. But still, I have “the psychological excitement of feeling that possibly nobody has yet thought of the crazy possibility I am looking at right now”, to paraphrase Feynman. Einstein also thought “if at first an idea does not sound absurd, then there is no hope for it.”

The proposal is an idea to allow us to “see” our world again in a simple view, something the complex mathematics and detached formalism of QM and other

theories has made difficult. It “visualizes” a possible scenario that leads to their conclusions without contradiction, while providing a possible explanation for some of the remaining mysteries, like Dark Matter and Dark Energy, Entanglement, and the “Reality” dilemma. As Rutherford once said, if you can’t explain a result in simple, non-technical terms, then you don’t really understand it. It doesn’t necessarily make it wrong, but it means you don’t really understand it, and that is exactly what everyone says about QM and String theory.



Einstein & Bohr

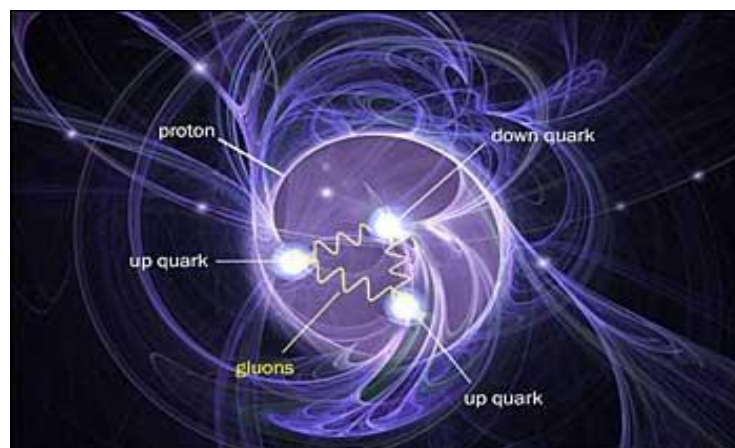


Dirac & Feynman

The immortal Feynman mused how “the fundamental laws of Physics, when discovered, can appear in so many different forms that are not apparently identical at first, but with a little mathematical fiddling you can show the relationship.” “We are struck by the very large number of different physical viewpoints and widely different mathematical formulations that are all equivalent to one another.” “Many different physical ideas can describe the same physical reality. Thus classical electrodynamics can be described as a field view, or an action at a distance view, etc. Originally, Maxwell filled space with idler wheels, and Faraday with Field lines, but somehow the Maxwell equations themselves are pristine and independent of the elaboration of words attempting a physical description.” He also thought different ideas are necessary, for “If every individual student follows the same current fashion in expressing and thinking about electrodynamics or field theory, then the variety of hypotheses being generated to understand... is limited”. We need

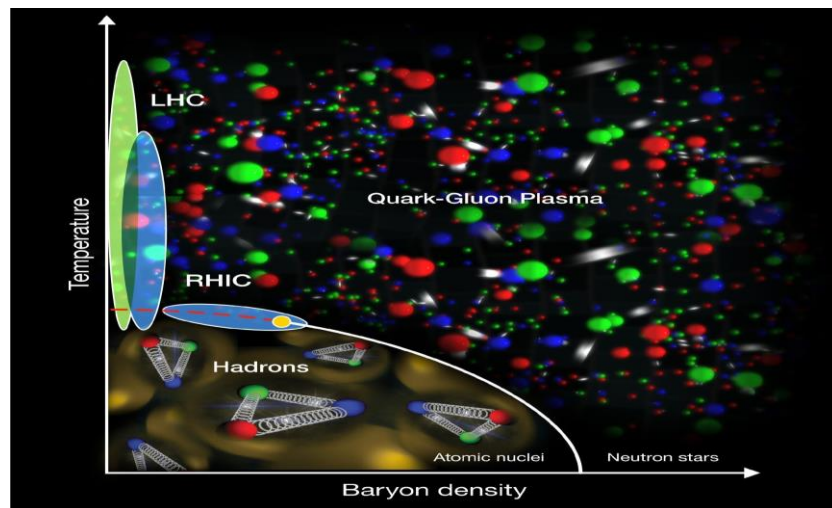
the van Flanderns in our world. He also thought that “A very great deal more truth can become known than can be proven.” Maxwell welcomed non-scientists’ opinions, saying: “Mathematicians, by guiding their thoughts always along the same tracks, have converted the field of thought into a railway system, and are apt to neglect cross-country speculations.” Those ideas, the “Free creations of the human mind”, always have the capacity to surprise us.

This is especially so when it comes to proposals of first principles. As Cotes says in his introduction to the Principia: “But shall gravity be therefore called an occult cause, and thrown out of philosophy, because the cause of gravity is occult and not yet discovered? Those who affirm this, should be careful not to fall into an absurdity that may overturn the foundations of all philosophy. For causes proceed in a continued chain from those that are more compounded to those that are more simple; when we are arrived at the most simple cause we can go no farther. Therefore no mechanical account or explanation of the most simple cause is to be expected or given; for if it could be given, the cause were not the most simple. These most simple causes will you then call occult, and reject them? Then you must reject those that immediately depend upon them, and those which depend upon these last, till philosophy is quite cleared and disencumbered of all causes”.



While we might agree with Bernoulli that “In Physical science one should banish the practice of explaining phenomena by chimerical principles more obscure than those presented for investigation”, it is hard to see how investigations of “primal causes” could proceed any other way. We cannot “keep looking under the lamp-post”, as String Theorist Strominger quipped un-awares. It is always good to keep an open mind – you never know when a good idea may enter. 50 years after the Big Bang theory, reading the “Electric

Universe” can still raise questions in your mind. Bohr himself had flipped his position on the duality of wave and particle, having said early on that “even if Einstein sends me a cable announcing the proof of the light quantum, the message cannot reach me because it has to be propagated by electromagnetic waves.”



The simplicity of the proposal ties the basics of logic (binary existence) to the correlations of mathematics (commutative and non-commutative), leading to an emanent “Existence Field”, whose interactions provide the “Reality” we perceive. Guided by the obvious interconvertibility of energy, mass (of all particle types) and charge, it posits One type of Particle – the “Proto-Light” Logical entity, whose multitudes and configurations create the rest in a “Logical” Hilbert Space of existence of multiple Dimensions. The economy of Nature is displayed at its most frugal, and yet most fruitful outcomes. The idea incorporates elements of SuperGravity, Super Symmetry, Loop Gravity, String Theory, QM and Relativity without conflicting with any. It is an attempt at the “Daring Conservatism” that Wheeler advocated.

It is time to get free of the hypnotic grip of the “can’t do” Copenhagen cult – a grip reinforced by the joy of mystics and philosophers at again having an un-understandable world where they can run loose again, and explore touchy-feely theories of consciousness, mind and matter and indulge their imagination. The quick surrender of the early QM pioneers has led to many rash conclusions, allowing many outside of science free rein to extrapolate. While this may be fun (in Science Fiction for example), it ultimately drove the

train off the track. It is time again for a vizualizable world, and many die-hards do have ideas for this, including some summarized in this proposal.

It is a qualitative proposal for the most part, but its quantitative heuristics seem to match the expected results. It is an idea that can be explained to a child, something Einstein (who liked to think in pictures, like moving trains and clocks) thought any useful theory should be. Many of the details are missing, but hopefully not as much as is needed for Pauli's blank rectangle he used "to show the world I can paint like Titian. Only technical details are missing". I am, after all, "so young and already so unknown", as the caustic Pauli described Frank Yang.

The study of numbers, geometry and harmony Socrates and Plato advocated unchains us from the confusion and mystery surrounding the complexity of the apparent world of our senses. Starting with the simple rules of logic, and building up a plausible model, a set of simple entities can provide the basis of inter-relationships. The complexity of the inter-relationships leads to the wonders we see about us – a Digital Universe, logic driving Geometry, Geometry driving Physics.

E Pluribus Unum



"We will first Understand how simple the Universe is when we recognize how strange it is." – John Archibald Wheeler

"If one stays in the middle of a country, one never reaches its borders." - Laloe

*"The real reason universities have students is to educate the professors."
– John Archibald Wheeler*

"Make everything as simple as possible, but not simpler." - Einstein

"Summing up we may characterize the framework of physical thinking ... as follows: There exists a physical reality independent of substantiation and perception. It can be completely comprehended by a theoretical construction which describes phenomena in space and time... The laws of nature imply complete causality... Will this credo survive forever? It seems to me that a smile is the best answer." - Einstein

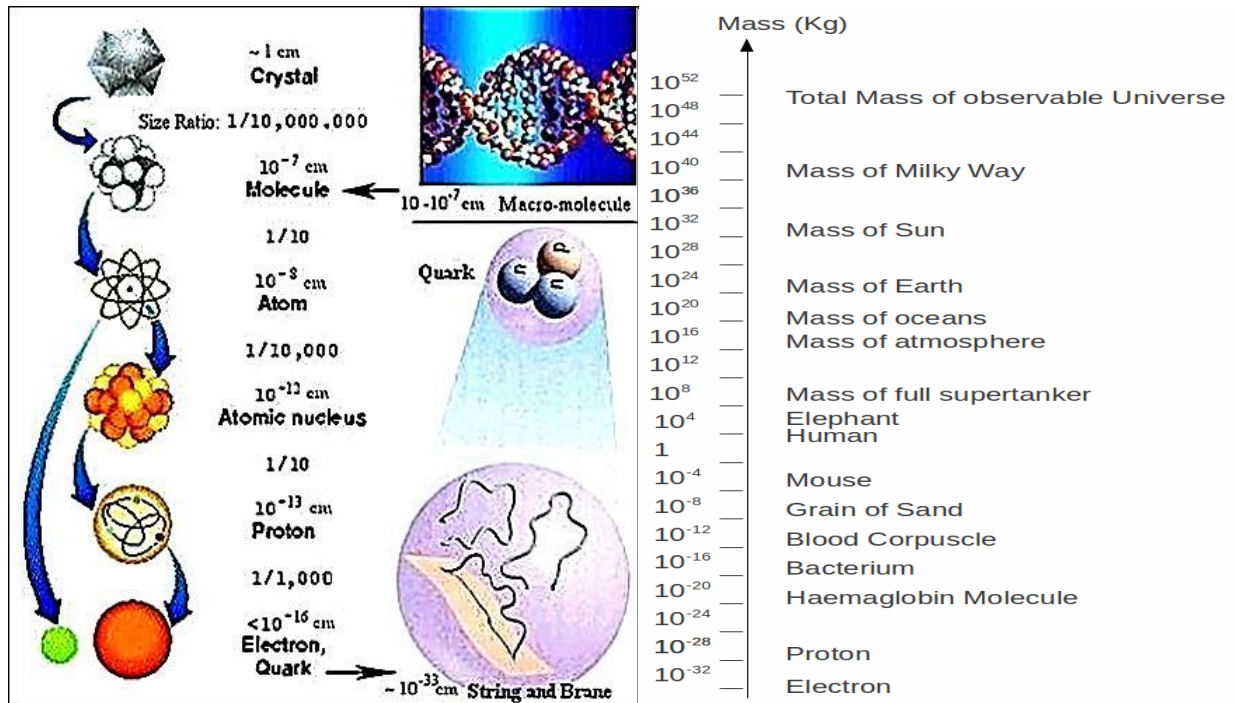
APPENDIX A - PL WORLD

A.1 - SOME NUMBERS & FORMULAS

Object	Mass (gm)	Compton Wavelength (cm)	Size (cm)
Photon (Red Light)	$3.4 \times 10^{-33} = E/c^2$	6.65×10^{-5}	Elementary Particle, Boson
Electron	9.1×10^{-28}	2.4×10^{-10}	Elementary Particle, Fermion
Proton	1.67×10^{-24}	1.3×10^{-13}	Composite Particle
Buckyball (C ₆₀)	1.2×10^{-21}	1.8×10^{-16}	$\sim 10^{-7}$
Protein	$\sim 10^{-19}$	2×10^{-18}	$\sim 10^{-6}$
Virus	$\sim 10^{-8}$	2.2×10^{-29}	$\sim 10^{-5}$
Object	Mass (gm)	Schwarzschild Radius (cm)	Size (cm)
Earth	6×10^{27}	0.9	6×10^8
Neutron Star	10^{34}	2×10^5	10^6
Cygnus X-1	2×10^{34}	4×10^5	Stellar Black Hole
SgrA*	8×10^{39}	1.2×10^{12}	Galactic Black Hole
3C273	4×10^{42}	6×10^{14}	Quasar Black Hole
Observable Universe	4×10^{55}	6×10^{27}	10^{28} (very close to form a Black Hole)

- h , Planck's constant = $6.62606957 \times 10^{-34} \text{ m}^2 \text{ kg} / \text{s}$
- Planck Length, ℓ_P , is a unit of length, equal to $1.616199(97) \times 10^{-35}$ metres
- $t_P \equiv \sqrt{\frac{\hbar G}{c^5}} \approx 5.39106(32) \times 10^{-44} \text{ s}$
- Based on Planck Length, the number of Planck Length Nodes in a cubic meter: $1/\ell_P$ cubed, = 0.235×10^{105} nodes, a lot of nodes (orders of magnitudes more than there are "particles" in the Universe).
- Radius of the Universe = 46.5 Billion Light years = $46.5 \times 10^9 \text{ LY}$
- 1 light year = 9.4605284×10^{15} meters
- Radius of Universe = 440×10^{24} meters (approx.)
- Volume of a sphere $V = \frac{4}{3}\pi r^3$
- Volume of the Universe = $4.2 \times 10^{78} \text{ m}^3$ approx; = $357 \times 10^{78} \text{ m}^3$
- Number of Nodes in Universe = 84×10^{183} nodes; With an estimated 10^{88} particles in the Universe, it is a sparse space indeed.
- Radius of Milky Way Galaxy = 50000 LY = approx 45×10^{19} meters
- Number of Nodes in Milky Way (approx) = 84×10^{165}

- Radius of Milky Way Halo ($5 \times$ radius of Galaxy) = 250×10^3 LY
- Number of Nodes in Halo = 10×10^3 168 nodes
- Solar Mass = 2×10^{30} Kg
- Mass of Milky way = 2×10^{11} Solar masses = 4×10^{41} Kg (Visible)
- Mass of Dark Matter in the Halo = approx 4-5 times visible mass. Approx 20×10^{41} Kgs
- Mass of Earth = 6×10^{24} Kg (approx)
- Radius of Earth = 6.3×10^6 meters; Volume = 1×10^{21} m³; density 6×10^3 kg/m³



Parameter	Value	Description
<i>Basic parameters</i>		
H_0	$70.9^{+2.4}_{-3.2} \text{ km s}^{-1} \text{ Mpc}^{-1}$	Hubble parameter
Ω_b	$0.0444^{+0.0012}_{-0.0035}$	Baryon density
Ω_m	$0.266^{+0.025}_{-0.040}$	Total matter density
<i>Derived parameters</i>		
ρ_0	$10.5^{+2.6}_{-2.9} \text{ kg/m}^3$	Critical density
Ω_Λ	$0.772^{+0.036}_{-0.048}$	Dark energy density
t_0	$13.73^{+0.13}_{-0.17} \times 10^9 \text{ years}$	Age of the universe

Mass, Momentum, and Energy

- Classical definitions
 - Mass m is constant
 - Momentum: $p = mv$
 - Kinetic energy: $KE = \frac{1}{2}mv^2 = p^2/(2m)$
- (Notation in Relativity)
 - Time just a direction
 - Theorists define $c = 1$
- Energy in Relativity
 - For objects at rest: $E = mc^2$
 - For objects in motion: $E^2 = p^2c^2 + m^2c^4$
 - Classical limit: small p $E \approx p^2/(2m) + mc^2$
- Total energy = sum of kinetic and internal parts
 - Mass is “internal energy”

Effects of Extra Dimensions

- Momentum in extra dimensions “invisible”
- Looks like “internal energy” — mass!

$$E^2 = p^2c^2 + (p_{\text{extra}}^2c^2 + m^2c^4)$$
- Quantum mechanics: $p_{\text{extra}} = \hbar n/R$
- Extra dimensions useful for unification
 - Gravity in an extra dimension looks like E&M

String Vibrations as Particles

- Natural length scale of strings — l_s — very small
 - l_s probably below 10^{-32} cm
 - We will always see strings as particles
- Vibration states have “mass” and “spin”
 - Spin from vibrations’ polarization
- Total vibration level labeled by (even) integer N
- Energy spectrum: $E^2 = p^2c^2 + 2(\frac{\hbar c}{l_s})^2 (N - 2)$
 - $N = 2$ states massless, “spin 2”: gravitons!

$$E = \frac{hc}{\lambda}$$

$E = \text{energy}$

$h = \text{Planck's constant}$

$c = \text{speed of light}$

$\lambda = \text{wavelength}$

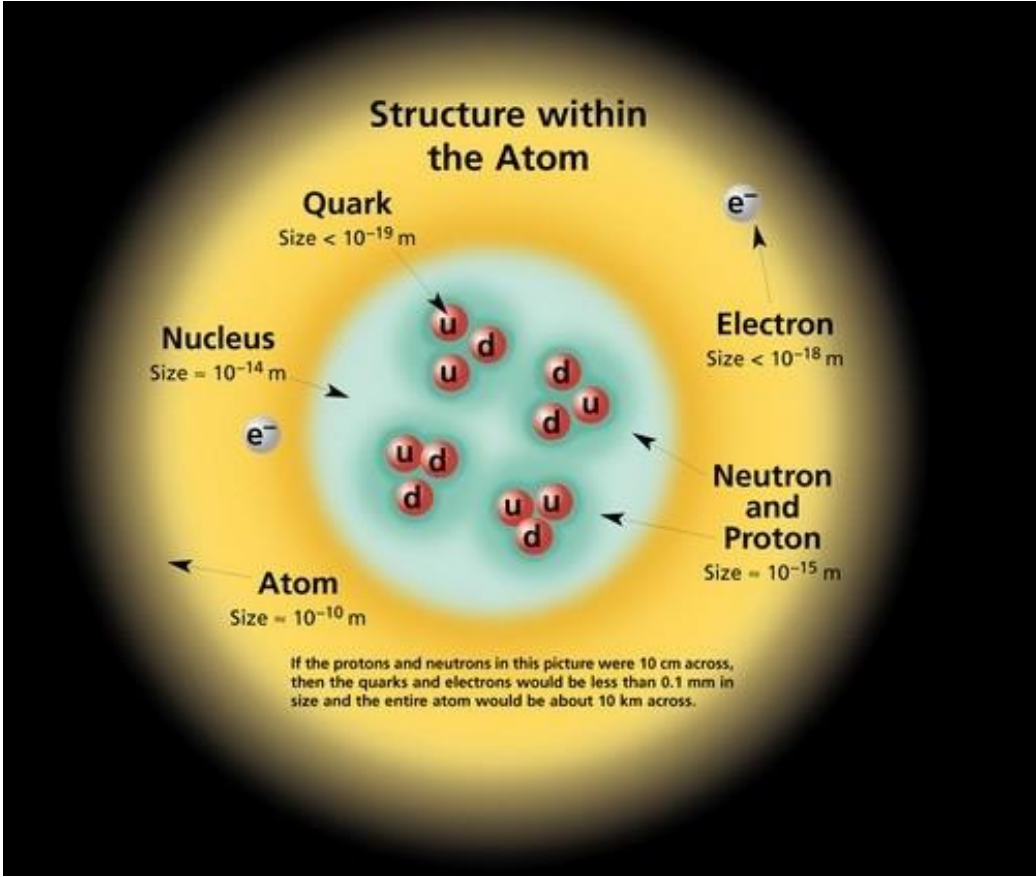
energy	energy	energy	frequency	wavelength	comparison	properties
eV	eV	Joules	Hertz	meters	in real world	
1	1	0.1602x10 aJ	242 THz	1.2μm	near infrared photon	for comparison
100 GeV	1x10 ¹¹	0.1602 μJ	2.41x10 ²⁵ Hz	1.2x10 ⁻¹⁷ m	Z boson	
1 TeV	1x10 ¹²	1.602 μJ	2.41x10 ²⁶ Hz	1.2x10 ⁻¹⁸ m	flying mosquito	produces Cherenkov light
10 TeV	1x10 ¹³	16.02 μJ	2.41x10 ²⁷ Hz	1.2x10 ⁻¹⁹ m	10 flying mosquitoes	air shower reaches ground 16 TeV highest energy detected
100 TeV	1x10 ¹⁴	0.1602 mJ	2.41x10 ²⁸ Hz	1.2x10 ⁻²⁰ m	ping pong ball falling off a bat	causes nitrogen to fluoresce
1 PeV	1x10 ¹⁵	1.602 mJ	2.41x10 ²⁹ Hz	1.2x10 ⁻²¹ m		
10 PeV	1x10 ¹⁶	16.02 mJ	2.41x10 ³⁰ Hz	1.2x10 ⁻²² m	potential energy of golf ball on a tee	
100 PeV	1x10 ¹⁷	0.1602 J	2.41x10 ³¹ Hz	1.2x10 ⁻²³ m		penetrate geomagnetic field
1 EeV	1x10 ¹⁸	1.602 J	2.41x10 ³² Hz	1.2x10 ⁻²⁴ m		
10 EeV	1x10 ¹⁹	16.02 J	2.41x10 ³³ Hz	1.2x10 ⁻²⁵ m	air rifle shot	

mass equivalent of 1 eV : 1.783×10⁻³⁶ kg

Orders of magnitude of Time					
Factor (s)	Multiple	Symbol	Definition	Comparative examples & common units	Orders of magnitude
10^{-44}	1 Planck time .	t_P	The time required to travel one Planck length at the speed of light (c).	$5.4 \times 10^{-20} \text{ ys} = 5.4 \times 10^{-44} \text{ s}$: One Planck time $t_P = \sqrt{\hbar G / c^5} \approx 5.4 \times 10^{-44} \text{ s}$ is the briefest physically meaningful span of time. It is the unit of time in the natural units system known as Planck units .	10^{-20} ys , 10^{-19} ys (10^{-44} s , 10^{-43} s)
10^{-24}	1 yoctosecond	ys	Yoctosecond , (<i>yocto-</i> + <i>second</i>), is one septillionth (short scale) of a second.	0.3 ys : mean life of the W and Z bosons . 0.5 ys : time for top quark decay , according to the Standard Model . 1 ys : time taken for a quark to emit a gluon . 23 ys : half-life of ${}^7\text{H}$.	1 ys and less , 10 ys , 100 ys
10^{-21}	1 zeptosecond	zs	Zeptosecond , (<i>zepto-</i> + <i>second</i>), is one sextillionth (short scale) of one second.	7 zs : half-life of helium-9's outer neutron in the second nuclear halo. 17 zs : approximate period of electromagnetic radiation at the boundary between gamma rays and X-rays . 300 zs : approximate typical cycle time of X-rays, on the boundary between hard and soft X-rays. 500 zs : current resolution of tools used to measure speed of chemical bonding	1 zs , 10 zs , 100 zs
10^{-18}	1 attosecond	as	One quintillionth of one second	12 attoseconds : shortest measured period of time.	1 as , 10 as , 100 as
10^{-15}	1 femtosecond	fs	One quadrillionth of one second	Cycle time for 390 nanometre light, transition from visible light to ultraviolet	1 fs , 10 fs , 100 fs
10^{-12}	1 picosecond	ps	One trillionth of one second	1 ps : half-life of a bottom quark 4 ps : Time to execute one machine cycle by an IBM Silicon-Germanium transistor	1 ps , 10 ps , 100 ps
10^{-9}	1 nanosecond	ns	One billionth of one second	1 ns : Time to execute one machine cycle by a 1 GHz microprocessor 1 ns : Light travels 30 centimetres (12 in)	1 ns , 10 ns , 100 ns
10^{-6}	1 microsecond	μs	One millionth of one second	1 μs : Time to execute one machine cycle by an Intel 80186 microprocessor 4–16 μs : Time to execute one machine cycle by a 1960s minicomputer	1 μs , 10 μs , 100 μs
10^{-3}	1 millisecond	ms	One thousandth of one second	4–8 ms : typical seek time for a computer hard disk 100–400 ms (=0.1–0.4 s): Blink of an eye 18–300 ms (=0.02–0.3 s): Human reflex response to visual stimuli	1 ms , 10 ms , 100 ms

10 ⁰	1 second	s		1 s: 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom. 60 s: 1 minute	1 s , 10 s , 100 s
10 ³	1 kilosecond (16.7 minutes)	ks	One thousand seconds.	3.6 ks: 3600 s or 1 hour 86.4 ks: 86 400 s or 1 day 604.8 ks: 1 week	10³ s , 10⁴ s , 10⁵ s
10 ⁶	1 megasecond (11.6 days)	Ms	One million seconds.	2.6 Ms: approximately 1 month 31.6 Ms: approximately 1 year $\approx 10^{7.50}$ s	10⁶ s , 10⁷ s , 10⁸ s
10 ⁹	1 gigasecond (32 years)	Gs	One billion seconds.	2.1 Gs: average human life expectancy at birth (2011 estimate) 3.16 Gs: approximately 1 century 31.6 Gs: approximately 1 millennium	10⁹ s , 10¹⁰ s , 10¹¹ s
10 ¹²	1 terasecond (32 000 years)	Ts	One trillion seconds.	6 Ts: time since the appearance of Homo sapiens (approximately)	10¹² s , 10¹³ s , 10¹⁴ s
10 ¹⁵	1 petasecond (32 million years)	Ps	One quadrillion seconds	7.1–7.9 Ps: 1 galactic year (225-250 million years) 143 Ps: the age of the Earth 144 Ps: the approximate age of the Solar system and the Sun . 430 Ps: the approximate age of the Universe	10¹⁵ s , 10¹⁶ s , 10¹⁷ s
10 ¹⁸	1 exasecond (32 billion years)	Es	One quintillion seconds.	312 Es: Estimated lifespan of a 0.1 solar mass red dwarf star.	10¹⁸ s , 10¹⁹ s , 10²⁰ s
10 ²¹	1 zettasecond (32 trillion years)	Zs	One sextillion seconds.	3 Zs: Estimated duration of Stelliferous Era . 9.8 Zs: the lifetime of Brahma in Hindu mythology	10²¹ s , 10²² s , 10²³ s
10 ²⁴	1 yottasecond (32 quadrillion years)	Ys	One septillion seconds.	1.6416 Ys: Estimated half-life of the meta-stable 83Bi radioactive isotope. 6.616×10 ⁵⁰ Ys: Time required for a 1 solar mass black hole to evaporate completely due to Hawking radiation , if nothing more falls in.	10²⁴ s , 10²⁵ s , 10²⁶ s and more

	Name	Equation	Describes
I	Gauss' Law for Electricity	$\oint \mathbf{E} \cdot d\mathbf{A} = q / \epsilon_0$	Charge and the Electric field
II	Gauss' Law for Magnetism	$\oint \mathbf{B} \cdot d\mathbf{A} = 0$	The Magnetic field
III	Faraday's Law of Induction	$\oint \mathbf{E} \cdot d\mathbf{s} = -d\Phi_B / dt$	A changing magnetic flux produces an electric field
IV	Ampere-Maxwell Law	$\oint \mathbf{B} \cdot d\mathbf{s} = \mu_0 \epsilon_0 d\Phi_E / dt + \mu_0 i$	A changing electric flux or a current produce a magnetic field



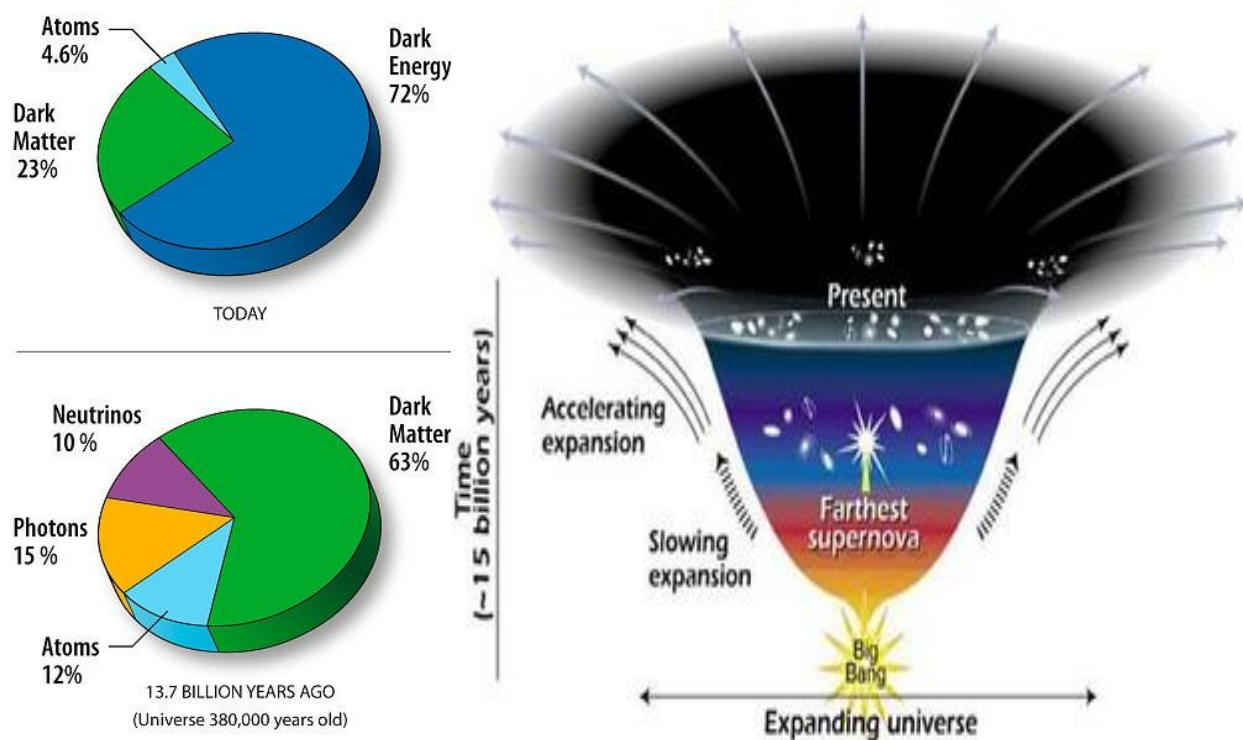
V·T·E		Particles in physics			
Elementary	Fermions	Quarks	 · · · · · · · · · · · 		
		Leptons	 · ⁺ · · ⁺ · ⁺ · ⁺ · _e · _e ⁺ · _μ · _μ ⁺ · _τ · _τ ⁺		
	Bosons	Gauge	 · · [±] · Z		
		Scalar	 ⁰		
	Others	Ghosts			
	Hypothetical	Superpartners	Gauginos	Gluino · Gravitino	
			Others	Axino · Chargino · Higgsino · Neutralino · Sfermion · Stop squark	
		Others	Planck particle · ⁰ · Dilaton · G · J · Majorana fermion · m · Tachyon · Leptoquark · X · Y · [±] · [±] · Sterile neutrino		
Composite	Hadrons	Baryons / Hyperons	N (p · n) · Δ · Λ · Σ · Ξ · Ω		
		Mesons / Quarkonia	 · · · ⁺ · ⁺ · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · </		

A.2 - DARK ENERGY DENSITY

Universal Vacuum density, assuming a flat space, ignoring mass clusters and Galactic spaces, assumed a small portion of overall volume, would be:

- Density/Node = “Dark Energy Estimate”/Number of Nodes

The Dark Energy estimate, if we take current assumptions, is about 73% of the “mass” of the Universe.



The estimate on the “Critical” Density is $9.30 \times 10^{-27} \text{ kg/m}^3$. This would mean the “average” Dark Energy is approximately $6.8 \times 10^{-27} \text{ kg/m}^3$. Calculating the per node density (uniformly spread one planck length apart), we get:

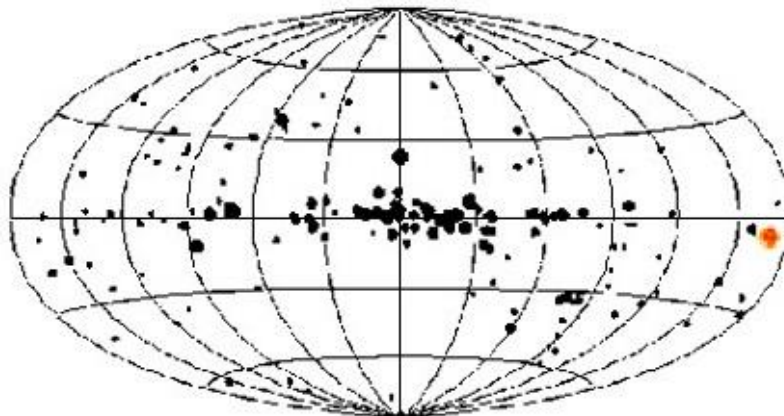
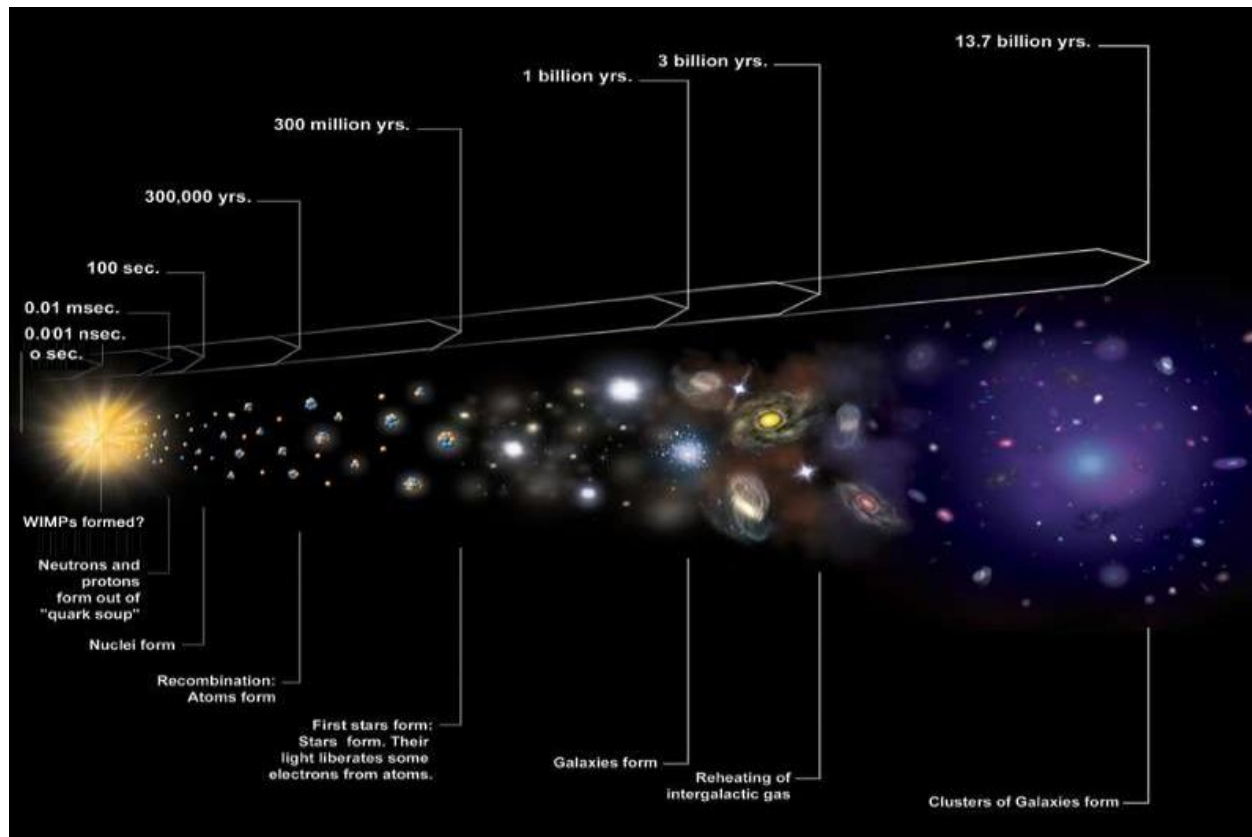
- Density per node = $28.9 \times 10^{-132} \text{ kg per Node}$

Assuming that the flat space scenario for Existence has an average of 1 PL per Node, (larger densities would lead to new nodes in steady state), then:

- PL “Energy” equivalent = $29 \times 10^{-132} \text{ Kg (approx)}$.

This is the Energy that is expanding Space. This **IS** Space!

The above assumes Space is “Fully Painted”- that the full Fabric is constructed of PL nodes a Planck distance apart. This is a likely proposition given the age of the Universe, and the diffusion of CBR. The 400 million photons per cubic meter of the CBR surely would have painted the entire canvas in 15 Billion years. However, it is possible “Space” has some empty patches where “Existence” has not made an appearance.



A.3 - DARK MATTER DENSITY

The Density of Dark Matter in the Halo, per Node:

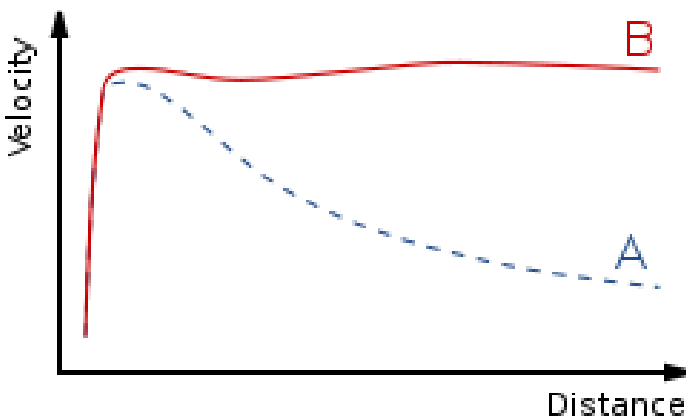
- Mass of Dark Matter/ Number of Nodes

This gives a density of $2 \cdot 10^{-127}$ Kg/Node.

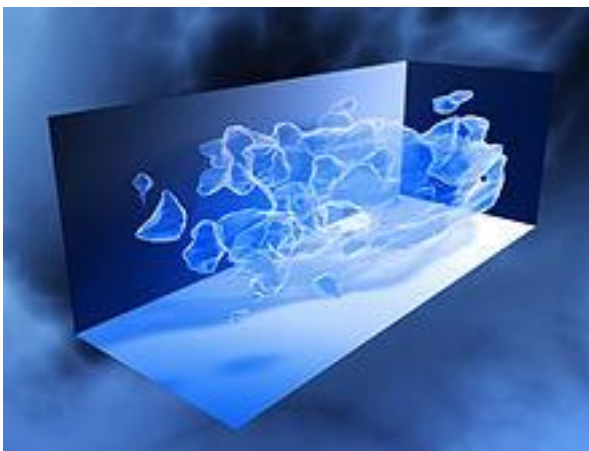
Using the PL mass obtained earlier, this is equivalent to a **dark matter density of $7 \cdot 10^{+3}$ PLs per Node.**

This indicates a resonant generation of about Seven Thousand PLs in the Halo of the Milky Way, the mass density there “exciting” the Existence space.

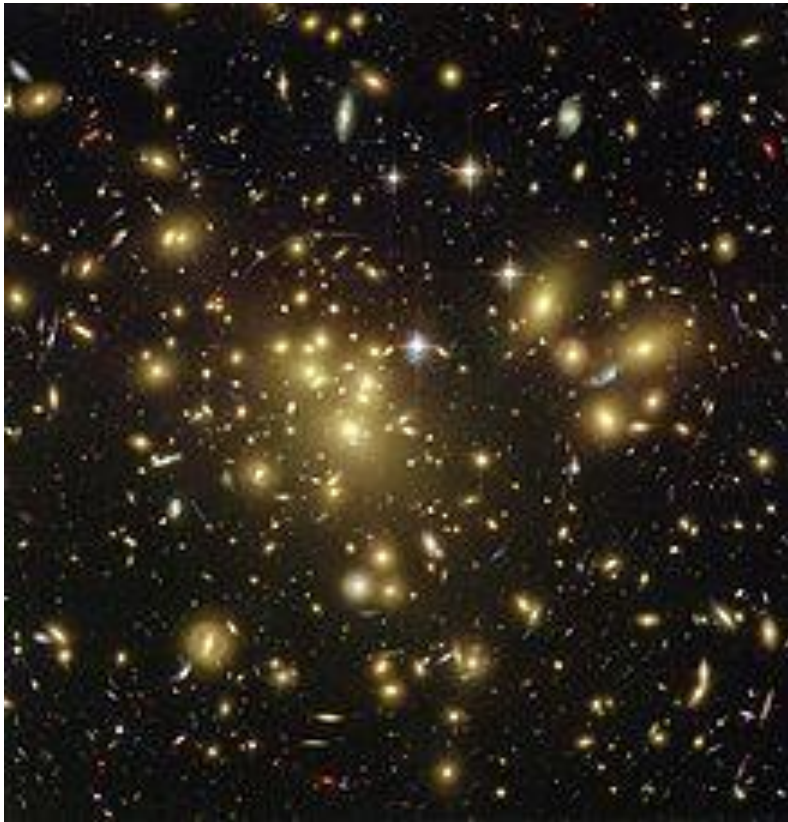
Notice that this density is extremely small when compared with matter density (below) - no wonder it is “dark” and unnoticeable. Its only impact is cosmological, since its total mass adds to the curvature of space around the Galaxy, giving the rotational impact that caused its detection in the first place.



Rotation curve of a typical spiral galaxy: predicted (A) and observed (B). Dark matter can explain the 'flat' appearance of the velocity curve out to a large radius

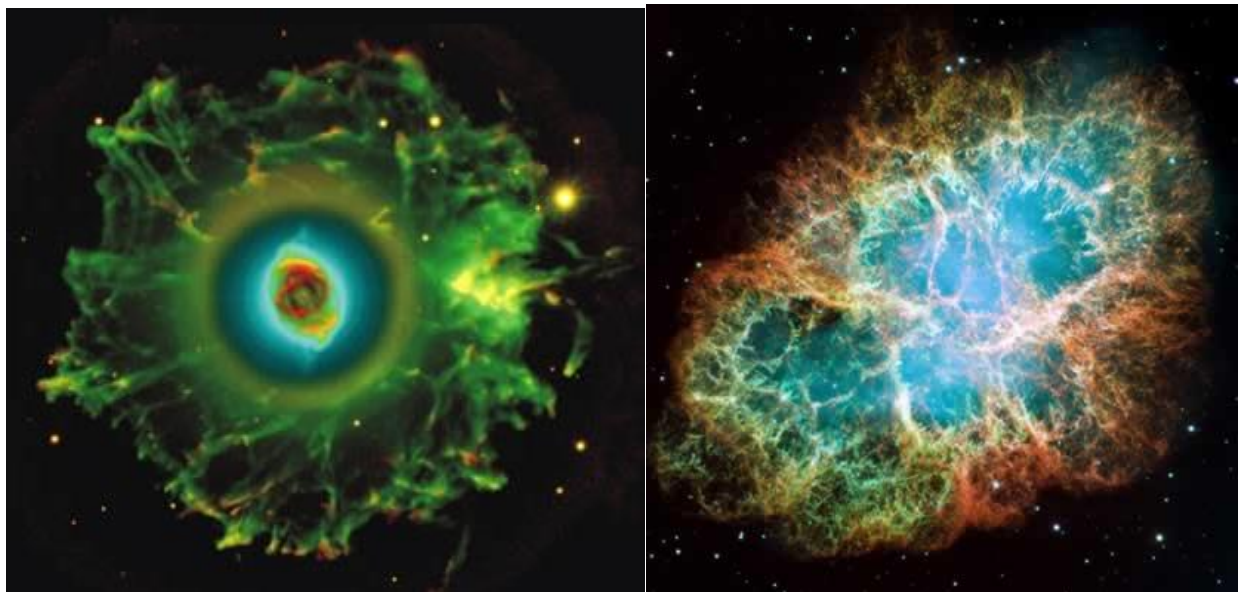


3D map of the large-scale distribution of dark matter, reconstructed from measurements of weak gravitational lensing with the Hubble Space Telescope



Strong gravitational lensing as observed by the [Hubble Space Telescope](#) in Abell 1689 indicates the presence of dark matter

Astronomers see those halos as diffuse, with densities about one millionth of “normal” baryonic matter in regions where they overlap, but in a much larger volume.

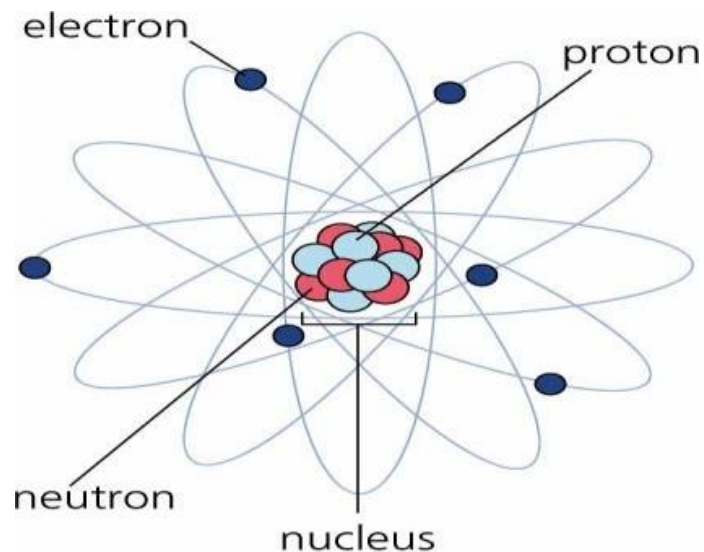


A.4 - MATTER DENSITY

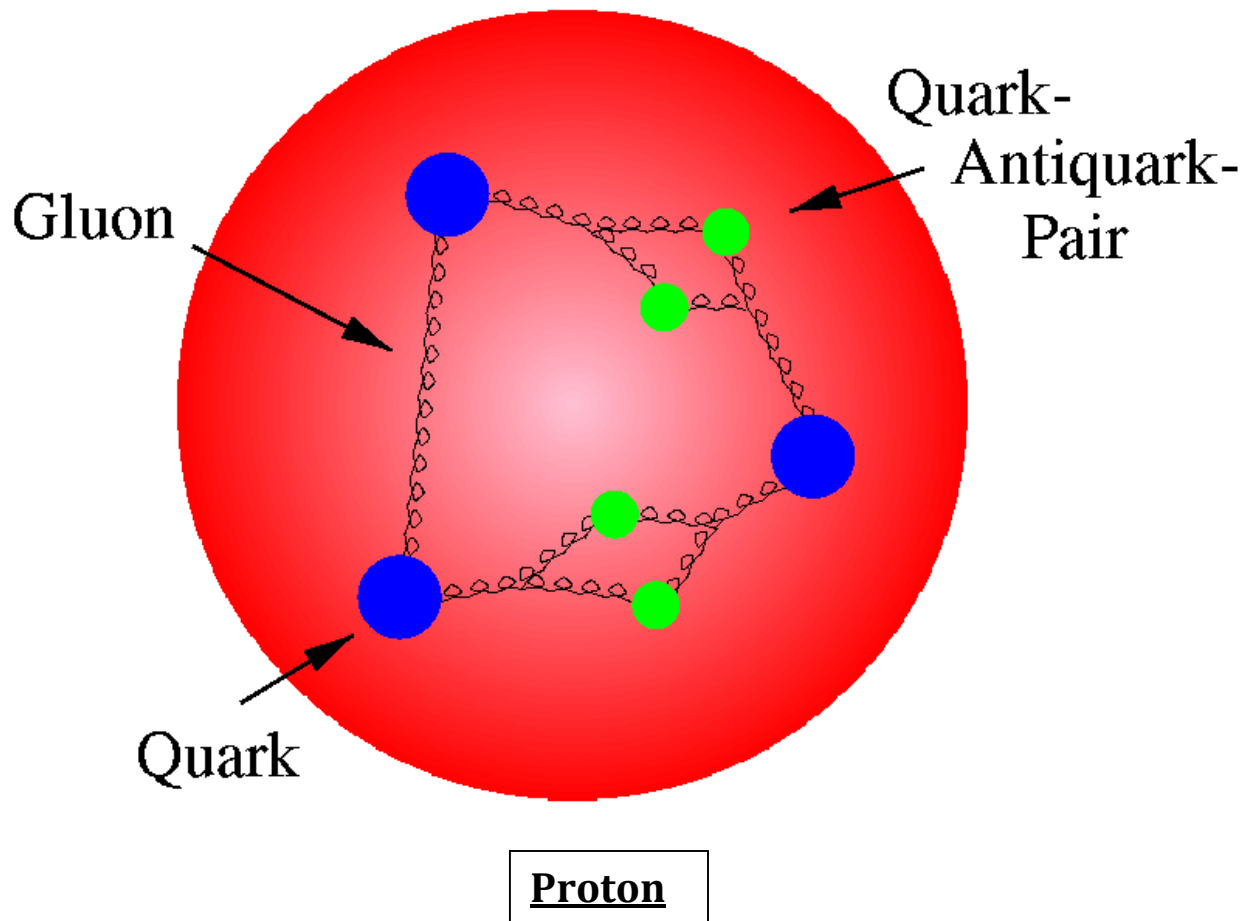
Earth Density is $6 \times 10^3 \text{ Kg/m}^3$; That is Roughly $25 \times 10^{-102} \text{ Kg/Node}$ approx... Translating into roughly **10+30 PLs per node matter density**. A lot of PLs.



Proton Density is even higher, since earth is essentially hollow – space barely filled with tiny baryons, the flies in Rutherford’s Cathedral.



The proton has a radius of approximately $1.0 \times 10^{-13}\text{cm}$ and a mass of $1.7 \times 10^{-24}\text{g}$, determining the density of a proton.
 (Volume of a sphere = $\frac{4}{3}\pi r^3$)

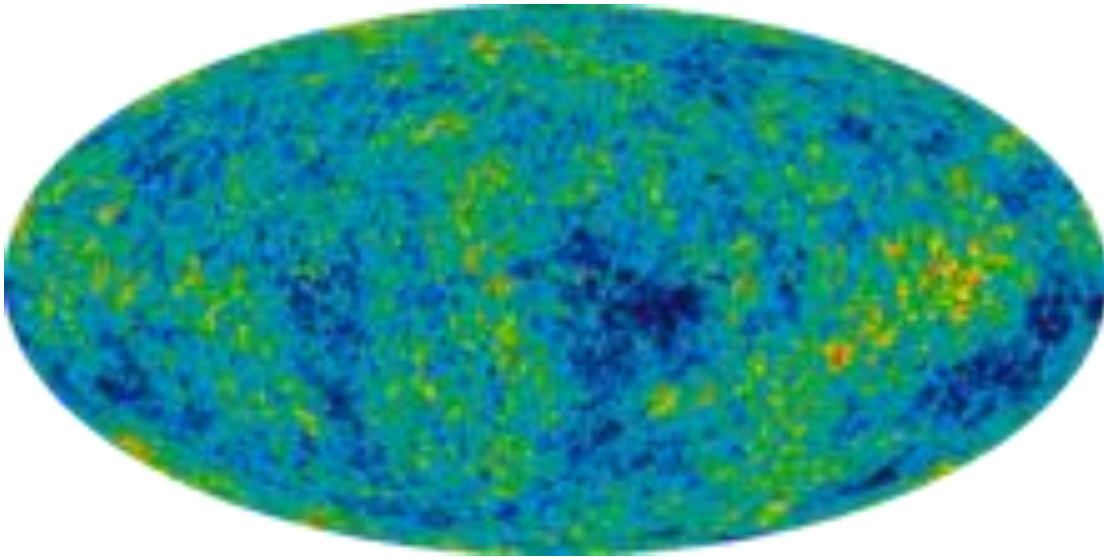


This gives: $4.2 \times 10^{14} \text{ g./cm.}^3$ – or $4.2 \times 10^{17} \text{ Kg/m}^3$... Approximately $80 \times 10^{88} \text{ Kg/Node}$; equivalent to roughly $3 \times 10^{44} \text{ PLs per node for a proton}$.

This makes matter (even ignoring the breakdown of the proton into finer components with even higher density) a very high Density PL cluster, justifying the proposal for Pilot PLs emanating from it, a minute fraction presenting a huge number of Pilots in space that provide the entanglement, charge effect, and other properties discussed in the PL proposal.

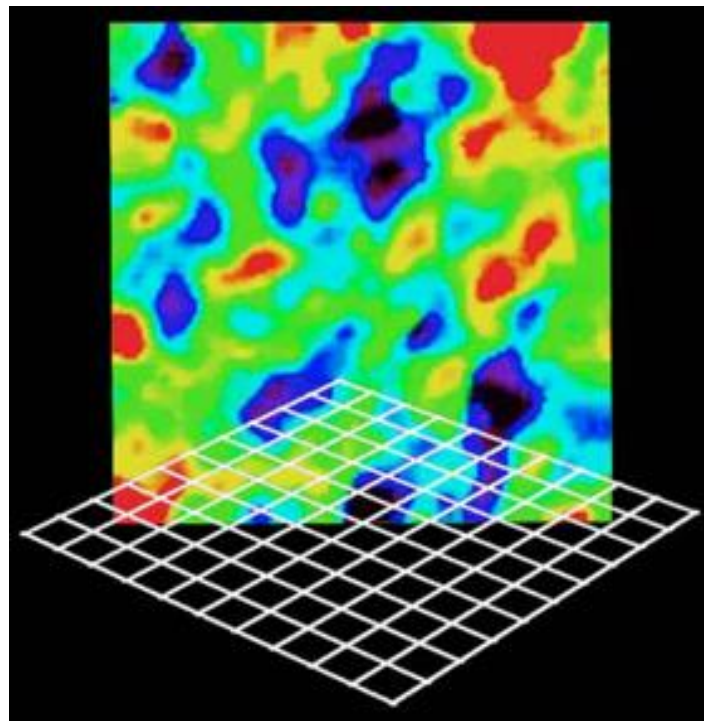
A.5 - CBR DENSITY

Just for Fun, let us figure the CBR density at the measured 2.7degrees Kelvin.



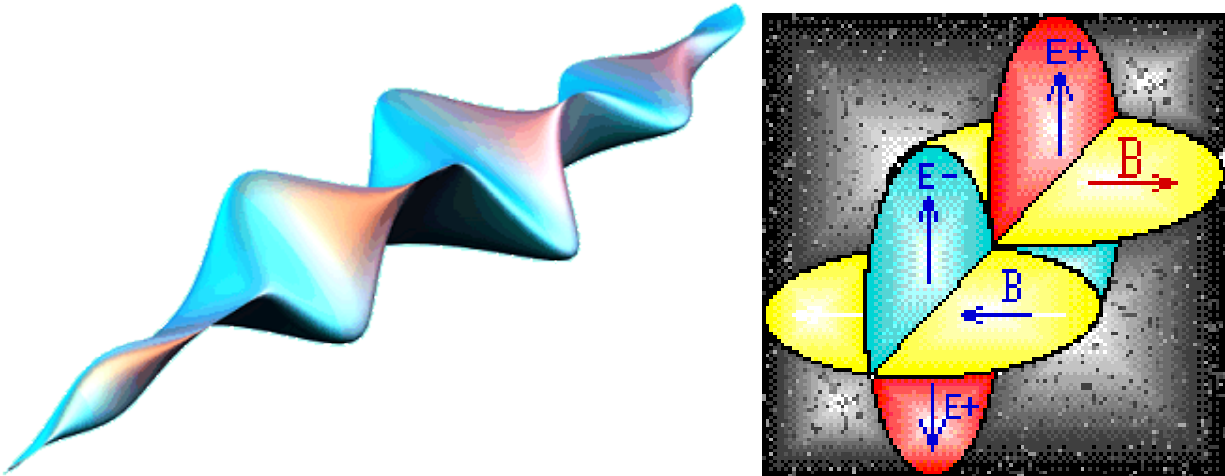
The average CBR Energy Density is $\text{CBR} = 4.20 \times 10^{-14} \text{ J/m}^3$, equivalent to $6 \times 10^{-28} \text{ kg/m}^3$ of matter.

That is about $30 \times 10^{-133} \text{ Kg/Node}$, or roughly 1 PL per 10 nodes! The CBR is about 1/10th the Dark Energy Density.



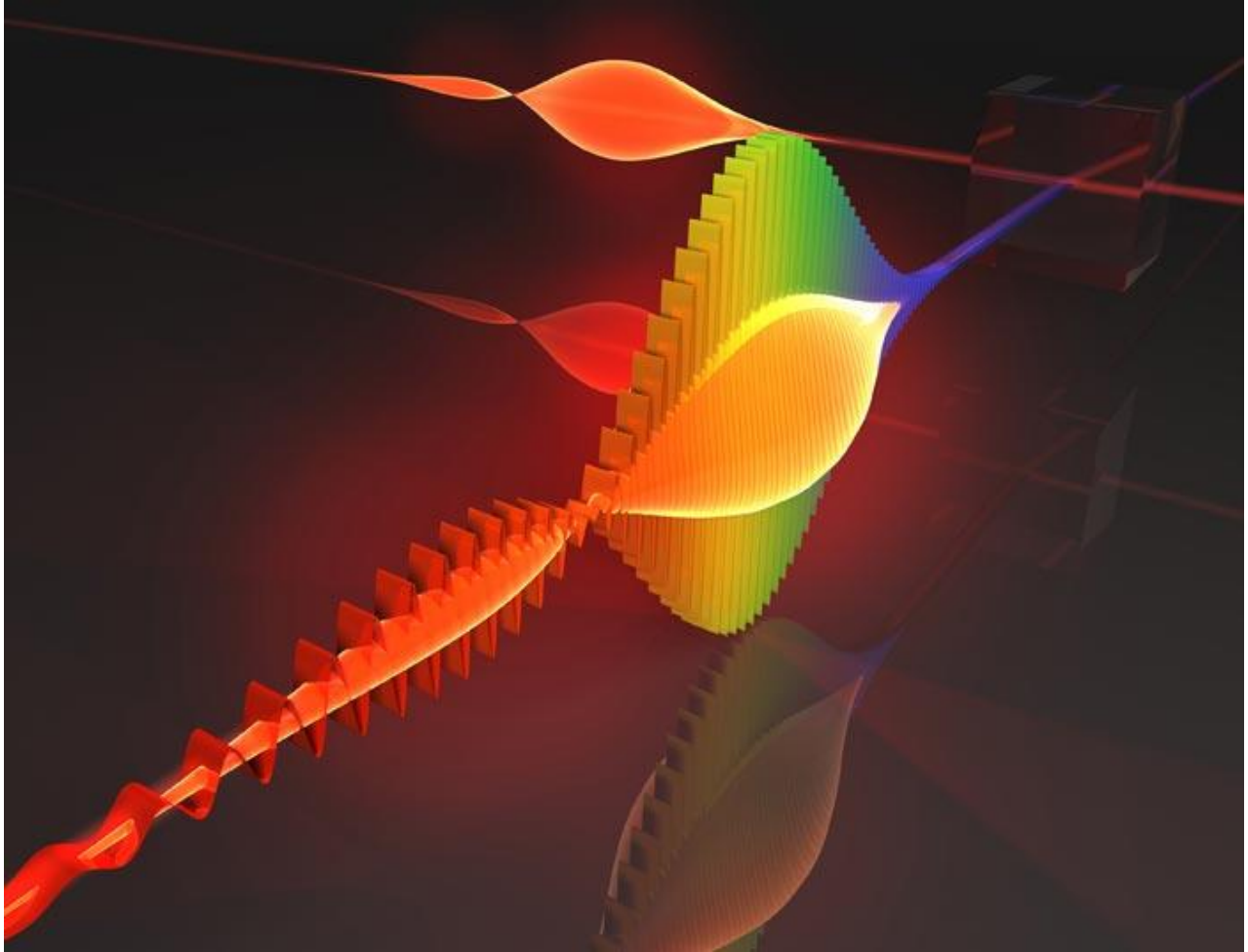
WMAP

But while the Dark Energy is spread over all the nodes unnoticed, the CBR energy is in photons, clusters of PLs, or PLCs. With 20 trillion photons in a cubic meter of sunlight, the average photon will contain about 10^{+91} PLs, enough to spread its pilots and entangle the universe.



It has been said that Nature provides an infinite regress, our knowledge growing surely and steadily, but Nature always unfolding one layer deeper, our search with no End. A reality shaped by Photons, with this huge density of logical PL constructs, enables such a Nature. The Myriads (literally 10,000, here an understatement if ever was one) of correlations these PLs afford can provide Nature with her infinite regress, and us with a constant source of puzzlement and opportunities. Nuclei will unfold Protons and Neutrons, Protons Quarks and Gluons, Quarks revealing Preons? Like a circle in a Spiral, like a Wheel within a Wheel, never ending or beginning... goes a favorite tune.





PL MOLDED PHOTON

Pulses of light can have almost any shape in space and time, and these shapes depend on the amplitudes and phases of the pulse's frequency components. Data can be encoded in light pulses by modulating the amplitude or phase of the light. Single photons and other quantum light states can also be generated in a variety of complex shapes and encoding information in these different shapes could be an efficient way to securely transmit data.

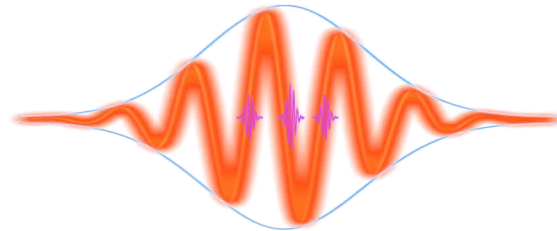
“With more knowledge comes a deeper, more wonderful mystery, luring one to penetrate deeper still. Never concerned that the answer may prove disappointing, with pleasure and confidence we turn over each new stone to find unimagined strangeness leading on to more wonderful questions and mysteries – certainly a grand adventure.”

Richard Feynman, “What Do YOU care What Other People Think?”

A.6 - PHOTON DIMENSIONS

Looking up photon dimensions on the internet, one finds many forums where the theme is: “that doesn’t make sense”, or “Quantum mechanics math says this is not a correct question”, including the rude “unless you know advanced QM formalism, you should not talk about it”. The Photon is perceived by most as a mathematical tool, a singularity in the EM field, and therefore not real. Quantum Mechanics experts seem to have discovered the Anti-Polaroid particle, that tries to prevent you from getting a clear picture of anything ☺. However, to paraphrase Johnson, if I hit the rude QM guy with a stone, I can see him wince via photons ☺. Not a single Faraday in the bunch.

If the length of a photon is defined and measurable, how long is lph and tph, the “length” of a photon and the “time” of a photon (time to cross its length)?



$E = h\nu = hc/lw$ (where lw is the wavelength of the **free** photon packet component oscillations (nuggets)). So $Tph = lph/c$; alternatively $c = lph/tph$; $E = h/tph * lph/lw$;

lph/lw represents the number of waves in the photon packets, each wave being the same size nugget of PLs, and hence the number of “nuggets” of PLs (Npl). The energy per PL nugget: $Epl = E/Npl = h/tph$.

Wavelength (m)	radiative lifetime(s)	Photon Length (m)	Photon Energy	spectrum
9.93609E-07	4.44267E-08	1.33E+01	0.001 KeV	IR

So let us try to estimate the number of PLs in an IR photon. The Photon has about $10+07$ cycles in it. Its equivalent “mass” is about $2*10^{-36}$ kgs. With a PL weighing in at $28.9*10^{-132}$ kg, gives about $0.7*10^{95}$ PLs for the photon, or about 10^{88} PLs per cycle. This is the thick PL fluid pumping the light!

An interesting perspective: If we take the EM “Cylinder” dimension to be filled with PLs in a planck length lattice, then the “radius” of that cylinder would be of the order of 10^{44} planck lengths, or $10^{44} * 1.616199(97) \times 10^{-35}$, about

1.6*10**9meters – definitely not well compactified. On the otherhand, we do not measure that dimension in cms and meters, but rather by its EM effect. In addition, the 10**44 factor may well explain why the EM effect is so much stronger than Gravity (described as 10**40 weaker in the Hierarchy problem), since EM geometric effects in the EM dimension would have to compare with the flat 3-dimensional space 1 PL density per node. While the EM PLs somehow map to “mass” in our 3-dimensions, their warp effects on that dimension would be significantly less than the effect in the EM dimension where it is most pronounced – basically gravity a “residual” effect diminished by the mapping of dimensions..

In trapped photon configurations, the “apparent” wavelength of the “particle” created by the resonance is the Compton wavelength, calculated also as above.

Electron Photonic Configuration:

For a photon at near the Electron energy,

Wavelength (m)	radiative lifetime(s)	Photon Length (m)	Photon Energy	spectrum
1.89516E-12	1.61623E-19	4.85E-11	655.1 KeV	x-ray hard

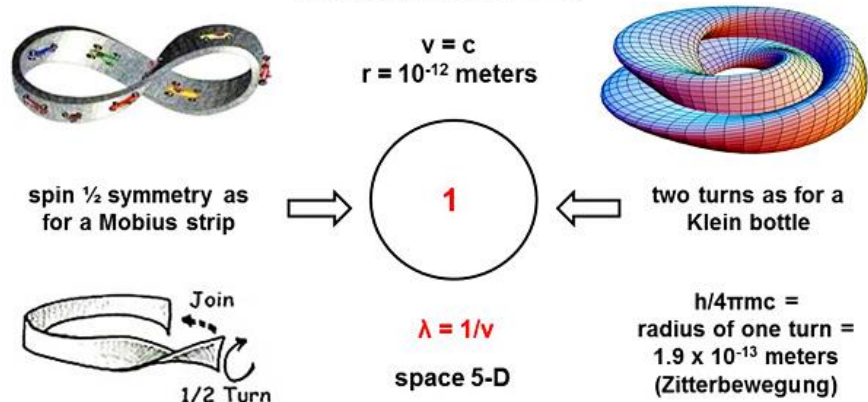
Bohr radius of an electron orbit in Hydrogen = 5.292×10^{-9} cm; The Bohr circumference of 3.325×10^{-8} cm;

Its electron rest energy $E = 8.19 \times 10^{-14}$ J would lead to an lw of: $Lw = hc/E$;
With $h = 6.626 \times 10^{-34}$ J-s and $c = 3 \times 10^{10}$ cm/s ; $hc = 19.878 \times 10^{-24}$ Jcm. Lw
(Compton wavelength for an electron) = 2.427×10^{-10} cm, basically the same
as the wavelength above. **The electron is that looped photon.**

The Bohr circumference is 134.7 times lw (Compton wavelength). Given our approximations, this is roughly the fine structure constant of 137.

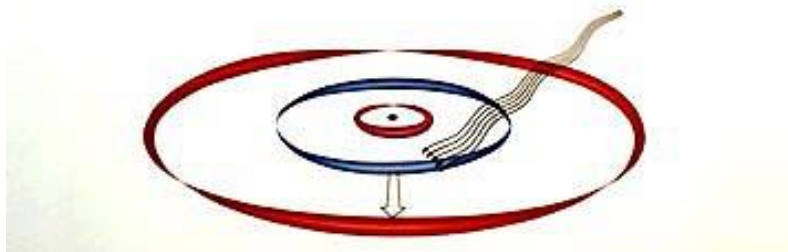
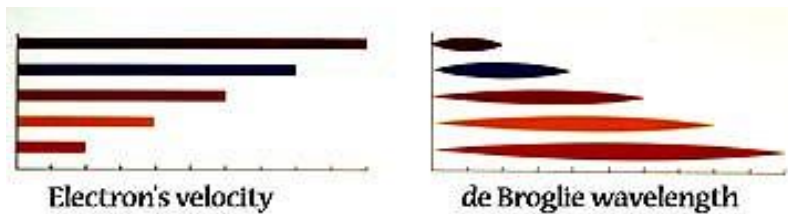
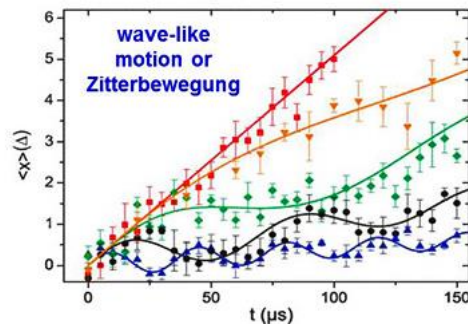
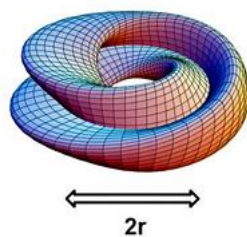
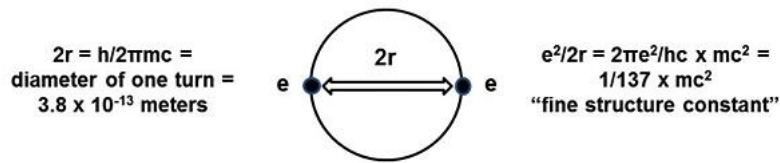
The classical electron radius of: 2.82×10^{-13} cm (not an experimentally measurable quantity yet), circumference of 17.72×10^{-13} cm, is much smaller than lw (factor of 137 exactly). (It is, however, in the range of the minimal wavelength we calculated earlier, the lowest EM wavelength, 7.6×10^{-14} m, in fact about a quarter! This means the electron circumference is roughly 1/4 the minimal allowed wavelength of EM radiation – in the range where matter formation becomes more favored). One can see a Mobius strip configuration (which emulates a spin $\frac{1}{2}$) for the photon going around.

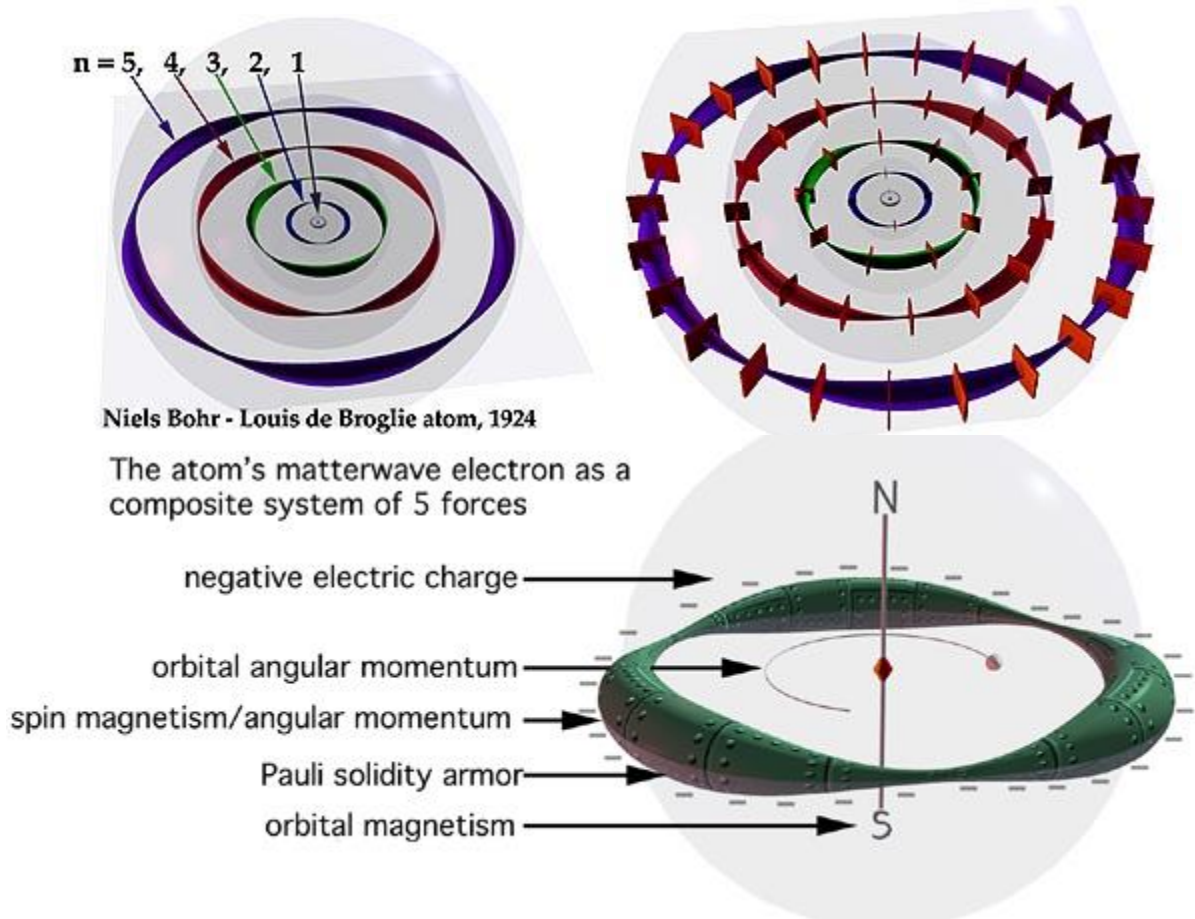
The first represents a contraction of any deBroglie wave $\lambda = h/mv$ with increased velocity v , eventually reaching the size of a Zitterbewegung or Compton wave for $v = c$



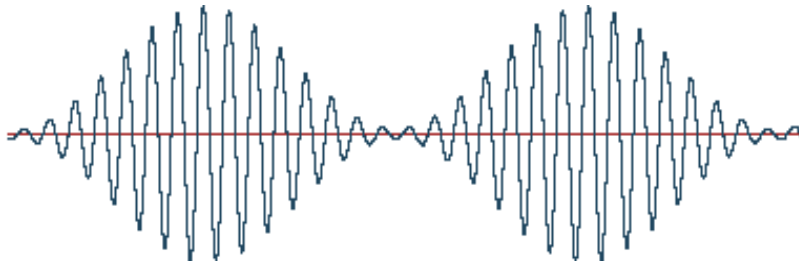
$$\frac{h}{mc} = \text{circumference over two turns} = 2.4 \times 10^{-12} \text{ meters (Compton)}$$

Such a vibratory motion may also explain quantum electricity, if two fast-rotating point charges repel one another across the Zitterbewegung wave by $e^2/2r = 1/137$ of mc^2



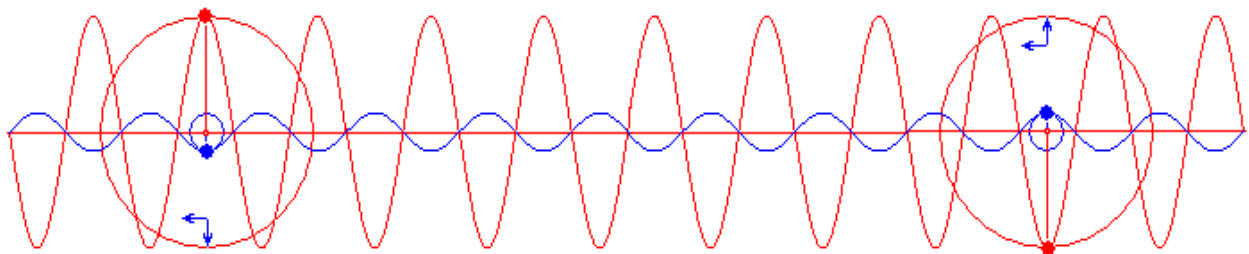
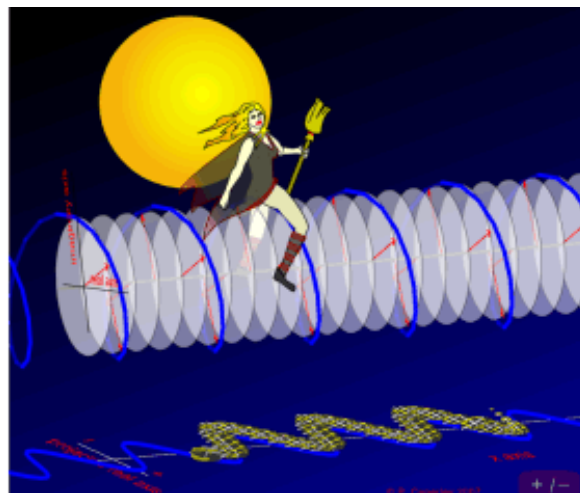
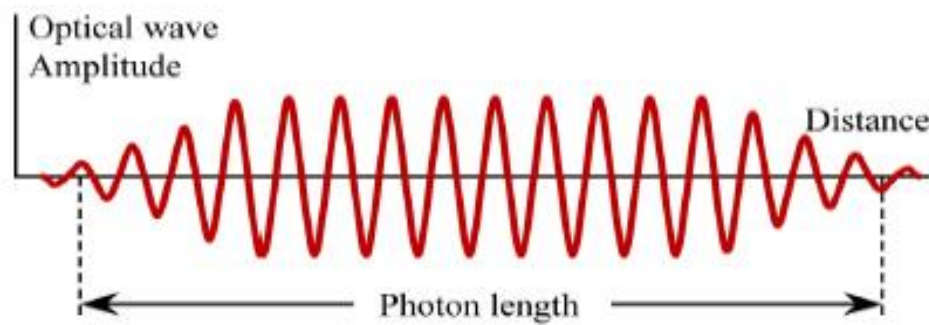


This would mean an electron is a photon, wrapped up 2 times in a circular formation whose circumference is $1/2$ the Compton photon wavelength, but exhibiting an actual circumference 137 times smaller. As the “compacted” photon (electron) goes around (spins), it would look like a “slower” wave, moving at $1/137$ the speed of light, with a longer wavelength of lw . In the case of the electron, this spinning configuration, (like a rotating earth itself rotating around the sun), also spins as a whole around the nucleus, on a path also 137 times lw - the magic number 137 seemingly a critical stability factor for spinning EM balls (perhaps related to the ratio of the pseudo-radius of the warped hyperbolic space they create, to the flat space radius), something Sommerfeld explained and derived as a result of the non-stationary orbit of the electron (a-la-Mercury Perihelion) driven by the Coulomb force. Thad Roberts derives this fine structure constant of 137 from the value of π in a warped space at quantum distances – which would explain the resonant orbits at the wavelengths indicated.

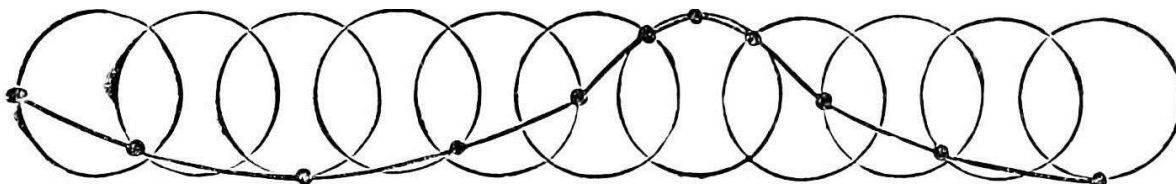


Two Photons (fixed length of nuggets);

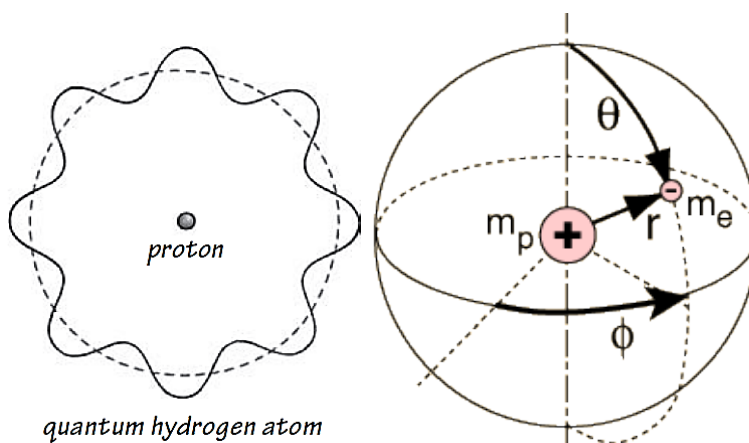
The “mass” of the electron is related to its PL density, but its perceived impact – via gravitation, the space-time metric, which is measured by its attraction to other “matter”, is not identical to the EM effects (in fact much smaller) due to the mapping of the PLs between the EM dimension and our 3-D space where Gravity is measured.



The diameter of the compacted photon loop would be the diameter of the electron, after taking into account relativistic effects and the fine structure constant (closely related).



Circling Photon presenting a longer effective wavelength L_w .



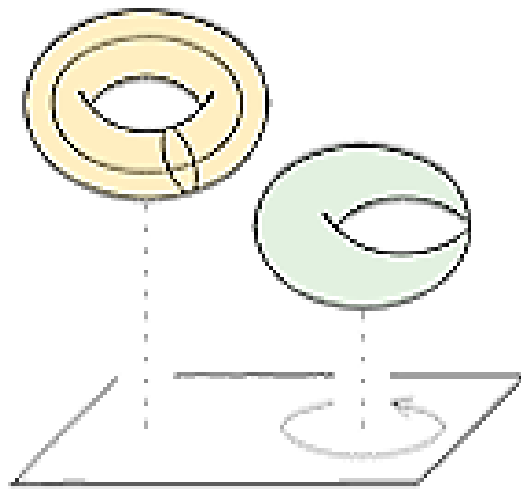
Another effect on the perceived diameter would be that the circular PL flow “compacts” the space inside it (a relativistic effect at the high speed), like a vortex compressing the flow into a tight spot, resulting in the smaller “perceived” electron radius. The Ehrenfest “paradox” for a uniformly rotating

system with the circumference
$$C' = \frac{2\pi R}{\sqrt{1 - v^2/c^2}}$$
 would mean that the circumference would look infinite for light, even as it circled around an (externally seen) small radius – looking bigger on the “inside” than it looks from the “outside”. Einstein’s relativity creates a circle whose ratio of circumference to diameter is no longer Pi, and there perhaps is the origin of the fine-structure constant. In fact, we can look at the electron as a “point particle” of sorts- with Radius Zero, but with a finite Circumference! The center of the electron would then look like a singularity in the space around it, which in quantum applications represents a 180degree shift – an interesting tidbit that explains why it requires a double circuit to close a path (a $2 \times 360^\circ$ symmetry) and hence spin $1/2$. An interesting note on Spin in general: it is an integer or integer + $\frac{1}{2}$ multiple of $h/2\pi$. Well, A photon’s momentum P is

related to the Photon wavelength by $PD=h$. So if our proposal is correct, and an electron is a spinning photon, wrapped around itself in a single wavelength, then its angular momentum (spin) = $r * mv = D/2\pi * P = h/2\pi$! Interesting...

The $\alpha = e^2 / hc / 2\pi$ equation strongly hints at the link between charge, photon energy, and the rotating photon picture. As the measure of electromagnetic attraction between photons and electrons, it actually may just be the ratio of the rotating photon wavelength and the electron radius, given the warp effected by the electron structure.

One interesting aspect of Duality from String Theory can also be called on to explain some of the physics of Electrons. If we view the rotating photon as a Loop String, then one can invoke String Dualities that equate the physics of a string around a torus to a string around its circumference. Hence the Electron circulating photon provides the same effect as a photon circulating around the Nucleus.

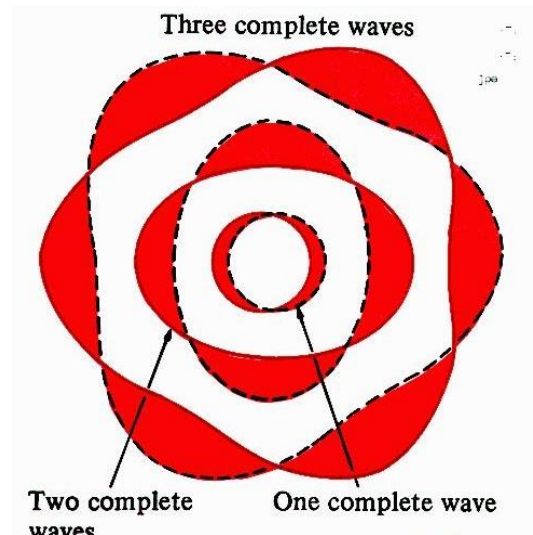
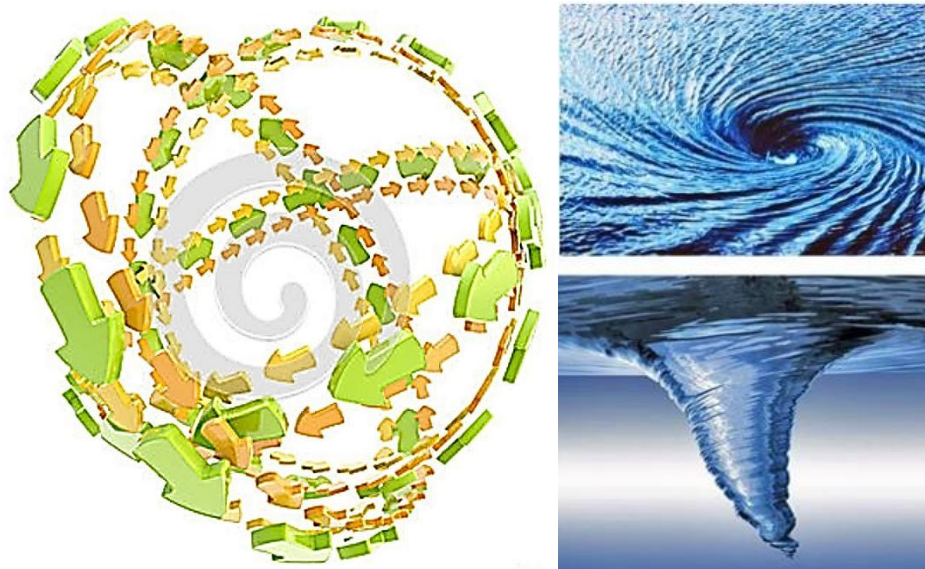


Proton Photonic Configuration:

For a proton, $E = 1.5 \times 10^{-10}$ Joule, so $Lw \text{ (proton)} = 13.52 \times 10^{-14} \text{ cm}$

Proton radius = $0.8 \times 10^{-16} \text{ cm}$, with a **circumference of $5 \times 10^{-16} \text{ cm}$** ; this means the proton is smaller than the lw (by a factor of 270, or almost 2×137 , again the magic factor of 137). The factor of two may be important in giving the positive charge of the proton versus the negative charge of the electron. It is also much smaller than the minimal EM wavelength **7.6 E-14 m** .

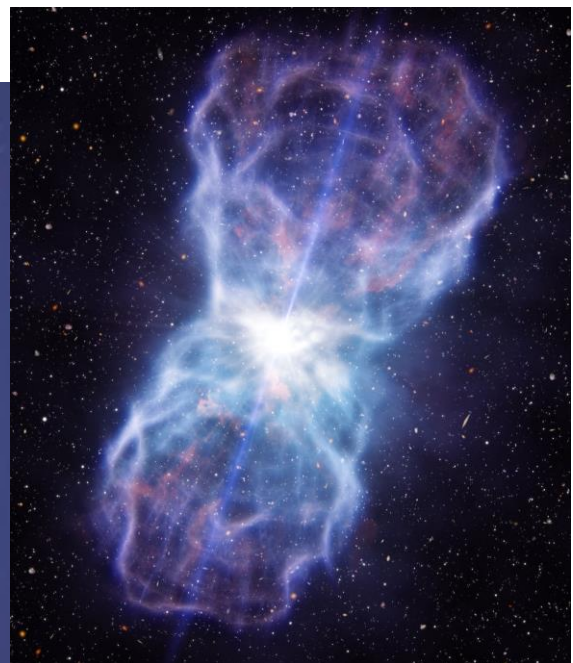
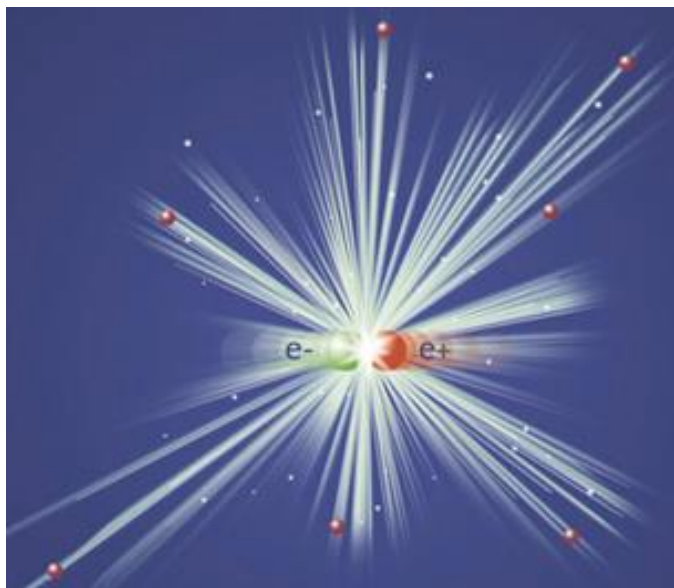
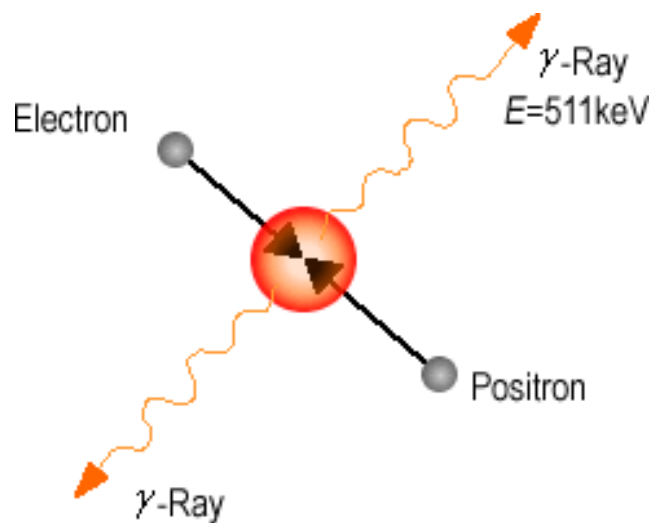
So the Proton could be a wrapped color photon, going around a circle, it warp effect on space giving an effective proton size smaller 2×10^{-137} than lw . But we know the proton to be composed of smaller particles, quarks, tied up with Gluons, and new theories presume the existence of Preons inside the quarks. This would make for lighter particles, with larger wavelength (but presumably smaller radius!). We may have to resort to the Ehrenfest paradox to figure out the orbital radius here. Since their energies are above our cutoff for oscillating EM photons, a different cut-off correlation may exist for “Color” Photons that compose the quarks, in a different dimension, where a different “elasticity” would cause a different formula than the one we have for EM photons, resulting in a different “smallest length” Color Photon.



Free Photons:

So when an electron annihilates, and is released into “free” EM energy, the resulting photon will have the same lw as the Compton wavelength of the electron. The “Tight” Photon that was circling as an electron now “relaxes”, and spreads out to the full wavelength (factor of 137) of the ring it was circling.

An electron and a positron (anti-electron) would be similar, but the rotation scheme would be anti-symmetrical, causing them to unlock each other when they collide, “freeing” the photons in the process.



SUGGESTED READING & RESOURCES

A *partial* listing of relevant material encompassing concepts used & discussed in this book:

- Don Lincoln – “Understanding the Universe”.
- Max Jammer series of masterpieces on the concepts of Space, Time, Mass, Force and Quantum Philosophy. A must read on the history of the evolution of our modern concepts of these critical ideas.
- Frank Wilczek’s “Fantastic Realities - 49 Mind Journeys and A Trip to Stockholm”, “The Lightness of Being, Mass, Ether, and the Unification of Forces”.
- Einstein, “Relativity, the Special and General Theory”.
- A. Einstein, B. Podolsky, and N. Rosen, “Can Quantum-Mechanical Description of Physical Reality be Considered Complete?”, *Physical Review*, 47, 1935.
- John Wheeler, “Spacetime Physics” (with E. Taylor), “Cosmic Catastrophes - Exploding Stars, Black Holes, and Mapping the Universe”, “Gravitation” (with Misner & Thorne), “Quantum Theory and Measurement” (ed., with Zurek), “Geometrodynamics and the Problem of Motion”.
- David Lindley, “Uncertainty, Einstein, Heisenberg, Bohr and the Struggle for the Soul of Science”, “Where does the Weirdness go”, “The End of Physics”.
- Werner Heisenberg, “Physics and Philosophy, the revolution in Modern Science”, “The Physical Principles of Quantum Theory”.
- John Bell, “Speakable and Unspeakable in Quantum Mechanics”, “The Foundations of Quantum Mechanics”.
- Mehra, Jagdish, “Einstein, Physics and Reality”; “The Golden Age of Theoretical Physics” (2 Vols.); “The Historical Development of Quantum Theory” (6 Vols.); “The Physicist’s Conception of Nature”.
- Peter Rowlands’ “Zero to Infinity”.
- Steven Weinberg, “The First Three Minutes”.
- George Gamow, “Thirty Years that Shook Physics”; Also Mr Tompkins’ adventures.
- Richard Feynman, “Quantum Electrodynamics”, “Feynman Physics Lectures”, “Nobel Lecture - The Development of the Space-Time View of Quantum Electrodynamics”, “The meaning of it all”, “The Character of Physical Law”, “Surely You’re Joking, Mr.Feynman!”, “What Do You Care What Other People Think”.
- Henderson H. , “Richard Feynman - Quarks, Bombs and Bongos”.
- James Gleick, “Genius: The Life and Work of Richard Feynman”.
- Roger Penrose, the massive “The Road to Reality”; “The Emperor’s New Mind”; “Shadows of Mind”; “Cycles of Time”.
- K Lang, “Sun, Earth and Sky”, “The Sun from Space”.
- Polkinghorne, “Quantum Mechanics, a short introduction”.
- Ernst Mach, “The Science of Mechanics”.

- Steven Hawking, "Brief History of Time", "The Grand Design", "The Nature of Space and Time" (with R. Penrose), "The Large Scale Structure of Space-Time" (with G.F.R. Ellis) and "Universe in a Nutshell".
- Carl Sagan, "Cosmos".
- Michio Kaku, any of his books, "Physics of the Impossible", "Parallel Worlds", "Visions – how science will revolutionize the Twenty First Century", "Physics of the Future", "Quantum Field Theory, A Modern Introduction", "Hyperspace – A Scientific Odyssey through Parallel Universes, Time Warps and the Tenth Dimension", "Beyond Einstein" recommended.
- Laurence Krauss, "The Physics of Star Trek", "A single Oxygen Atom's journey from the Big Bang to life on Earth... and beyond", "A Universe from Nothing", "Hiding in the Mirror", plus any of his easy reads.
- Lee Smolin, "The Trouble with Physics", "The Life of the Cosmos", "An invitation to Loop Quantum Gravity".
- John Bell, "Speakable and Unspeakable in Quantum Mechanics".
- Amir Aczel, "God's Equation", and "Entanglement – the Greatest Mystery".
- Steven Gubser, "The Little Book of String Theory".
- Brian Greene, "The Elegant Universe", "The Hidden Reality" or any of his books.
- Thomas Kuhn, "The Structure of Scientific Revolutions".
- Jim Al-Khalili, "Quantum – A guide for the perplexed". "Black Holes, Wormholes & Time Machines".
- Gerrit Verschuur, "Hidden Attraction".
- Wallace Thornhill, David Talbott, "The Electric Universe".
- Joel Morrison, "Sorce Theory – Unlocking the Basement".
- Thad Roberts, "Einstein's Intuition". Quoted with Permission.
- David Deutsch, "The Fabric of Reality".
- F. Laloe, "Do we really understand Quantum Mechanics".
- Michael Fayer, "Absolutely Small How Quantum Theory Explains Our Everyday World".
- N. David Mermin, "It's About Time – Understanding Einstein's Relativity".
- Paul Davies & Niels Gregersen, "Information and the Nature of Reality".
- Alastair Rae, "Quantum Physics – Illusion or Reality?"
- V. Scarani, "Quantum Physics - A First Encounter - Interference, Entanglement and Reality".
- Kent Peacock, "The Quantum Revolution".
- G. E. Volovik, "Superfluid analogies of cosmological phenomena", "Cosmology, Particle Physics, and Superfluid 3He", "The universe in a Helium droplet". Quoted with Permission.
- Harold Aspden, "Physics without Einstein", "Physics Unified".
- John Barrow, "The Constants of Nature", "Pi in the Sky", "The Book of Nothing", "Impossibility, the Limits of Science", "Between Inner Space and Outer Space", "The Anthropic Cosmological Principle", "Fitness of the Cosmos for Life- Biochemistry

and Fine Tuning”, “The Artful Universe”, “New Theories of Everything, the quest for Ultimate explanation”.

- Abraham Pais, “Subtle is the Lord”, “Paul Dirac, the Man and his Work”, “J. Robert Oppenheimer, a Life”, “Neil Bohr’s Times, in Physics, Philosophy, and Polity”.
- Frank Tipler, “The Physics of Immortality”.
- Alfred North Whitehead, “Process and Reality”.
- Roel Snieder, “A guided Tour of Mathematical Physics”.
- Abbe georges Lemaitre, “The Primeval Atom”
- Diego Marin, Fabrizio Coppola, Marcello Colozzo, “The arrangement field of the space-time points”.
- Diego Meschini, Markku Lehto, Johanna Piilonen, “Geometry, pregeometry and beyond”.
- N. V. Pope, A. D. Osborne, “Instantaneous Relativistic Action-at-a-Distance”; “Instantaneous gravitational and inertial Action-at-a-distance”.
- Harvey R. Brown, Oliver Pooley, “The origin of the Spacetime metric: Bell’s ‘Lorentzian Pedagogy’ and its significance in general relativity”.
- J. Larmor, “Aether and Matter”.
- I. Prigogine, “Order out of Chaos”, “From Being to Becoming”.
- R. B. Griffiths, “Consistent Quantum Theory”.
- L. Janossy, “Theory of Relativity Based on Physical Reality”.
- D. Bohm, D. J. Hiley, “The Undivided Universe”.
- B. S. DeWitt, N. Graham, “The Many-Worlds Interpretation of Quantum Mechanics”.
- N. David Mermin, “What is Quantum Mechanics Trying to Tell Us”.
- B. D’Espagnat, “Conceptual Foundations of Quantum Mechanics”.
- “Universe Today” website.
- R. T. Cahill, C. M. Klinger, “Process Physics: Modelling Reality as Self-Organizing Information”; “Self-Referential Noise as a fundamental Aspect of Reality”; “Bootstrap Universe from Self-Referential Noise”.
- R. T. Cahill, “Gravity as Quantum Foam Flow”, “A New Light-Speed Anisotropy Experiment: Absolute Motion and Gravitational Waves Detected”.
- H. A. Munera, “Michelson-Morley Experiments Revisited: Systematic Errors, Consistency Among Different Experiments, and Compatibility with Absolute Space”.
- L. Hardy, “Quantum Mechanics, Local Realistic Theories and Lorentz-Invariant Realistic Theories”.
- I.C. Percival, “Quantum Measurement Breaks Lorentz Symmetry”.
- R. T. Cahill, K. Kitto, “Michelson-Morley Experiments Revisited and the Cosmic Background Radiation Preferred Frame”.
- Simon E. Schnoll, “Changes in the fine structure of stochastic distributions as a consequence of space-time fluctuations”; “Experiments with Radioactive Decay of Pu239: Evidence Sharp Anisotropy of Space”.
- Stephan Gift, “Light Speed Invariance is a Remarkable Illusion”.
- H. E. Ives, “Revisions of the Lorentz Transformations”.
- Sid Deutsch, “Return of the Ether: Conjecture That Can Explain Photon and Electron Two-Slit Interference”.

- E. I. Shtyrkov, "Observation of Ether Drift in Experiments with Geostationary Satellites".
- S. Marinov, "New Measurement of the Earth's Absolute Velocity with the Help of the "Coupled Shutters" Experiment".
- Frederick Rothwarf, Sisir Roy, "Quantum Vacuum and a Matter - Antimatter Cosmology", based on Allen Rothwarf model.
- Allen Rothwarf, "An Aether Model of the Universe".
- Vlatko Vedral, "Decoding Reality".
- Ian C. Percival, "Quantum measurement breaks Lorentz symmetry"
- Thomas J. Roberts, "An Explanation of Dayton Miller's Anomalous "Ether Drift" Result".
- Hermann Bondi, "Negative Mass in General Relativity".
- Claude Fayette Bragdon, "A Primer of Higher Space".
- Antoine Suarez, "Nonlocal "realistic" Leggett models can be considered refuted by the before-before experiment".
- A. J. Leggett, A. Garg, "Quantum mechanics versus macroscopic realism: Is the flux there when nobody looks?". A. J. Leggett, "Testing the Limits of quantum mechanics: motivation, state of play, prospects".
- Emary, Lambert, Nori, "Leggett-Garg Inequalities".
- Hasewaga et al., "Falsification of Legget's Model using neutron matter waves".
- N. Chandrasekar, "Quantum Mechanics of Photons".
- Iwo Bialynicki-Birula, "The Photon Wave Function".
- Peter Mohr, "Solutions of the Maxwell equations and photon wave functions".
- G. F. Chew, H. P. Stapp, "Three-Space from Quantum Mechanics".
- Lee Smolin, "Cosmology as a problem in critical phenomena"; "Self-organized criticality in quantum gravity".
- Frijtof Capra, "The Tao Of Physics".
- Stuart Kauffman, "Origins of Order: Self-Organization and Selection in Evolution".
- Per Bak, "How Nature Works".
- Albert Einstein, "Ether and Relativity".
- Specific Ideas site: <http://photontheory.com/pte.html>
- F. Capra, "Bootstrap Physics: A Conversation with Geoffrey Chew".
- M. Heller, W. Sasin, "Groupoid approach to noncommutative quantization of gravity".
- M. Heller, W. Sasin, "Emergence of time".
- Michael Heller, "Evolution of Space-Time Structures".
- David Ritz Finkelstein, "Nature as Quantum Computer".
- C. N. Yang, "On Quantized space-time".
- J.G.Williamson, "A new theory of light and matter".
- J. G. Williamson, M. B. van de Mark, "Is the electron a photon with toroidal topology?"
- C. W. Misner, J. A. Wheeler, "Gravitation, Electromagnetism, Unquantized Charge, and Mass as Properties of Curved Empty Space".
- A. O. Barut, A. Grant, "Quantum Particle-like configurations of the electromagnetic field".

- U. Enz, "A new type of soliton with particle properties".
- B. Kivel, "Photon theory of the electron".
- Paris Panagiotopoulos, "Nonlinear Airy and Airy-like wavepackets".
- R. P. Feynman, R. B. Leighton, M. Sands, "Electromagnetic Mass".
- M. B. Van der Mark, G. W. 't Hooft, "Light is Heavy".
- Lev Okun, "The Concept of Mass".
- M. Berry, I. Marzoli, W. Schleich, "Quantum carpets, carpets of Light".
- F. Selleri, "Recovering the Lorentz Ether".
- A. Sorli et al, "New Insights Into the Special Theory of Relativity".
- M. Villata, "CPT symmetry and anti-matter gravity in general relativity".
- R. M. Santilli, "A Classical Iso-Dual Theory of Anti-Matter and its Prediction of AntiGravity"; "Apparent detection of AntiMatter Galaxies via a refractive telescope with concave lenses".
- E. Moreva et al, "Time from quantum entanglement: an experimental illustration".
- John Marburger, "Constructing Reality".
- D.L. Burke, R.C. Field, G. Horton-Smith, J.E. Spencer, D. Walz, "Positron Production in Multiphoton Light-by-Light Scattering".
- John. E. Carroll, "A photon-like wavepacket with quantised properties based on classical Maxwell's equations".
- Physics Discussion Forum (PDF) – Good input from Farsight (John Duffield) and Good Elf.
- Frank Close, "AntiMatter", "Particle Physics, A Very Short Introduction", "The Infinity Puzzle".
- P.A.M. Dirac, "The Principles of Quantum Mechanics".
- Helge Kragh, "Conceptions of Cosmos", "Quantum Generations", "Dirac- A scientific biography".
- E. Nelson, "Quantum Fluctuations".
- D. Aerts & Sven Aerts, "Towards a General Operational and Realistic Framework for Quantum Mechanics and Relativity Theory".
- D. Aerts, "The entity and modern physics: the creation-discovery- view of reality".
- D, Aerts & B. Coecke, "The creation-discovery-view: towards a possible explanation of quantum reality".
- H. Dieter Zeh, "John Bell's Varying Interpretations of Quantum Mechanics".
- Daniel F. Styer, "The Strange World of Quantum Mechanics".
- Banesh Hoffman, "The Strange Story of the Quantum".
- F. Close, M. Marten, C. Sutton, "Particle Odyssey – A Journey to the Heart of Matter".
- B.J. Hiley, "From the Heisenberg Picture to Bohm: a New Perspective on Active Information and its relation to Shannon Information".
- David Bohm, "A new theory of the relationship of mind and matter"; "Wholeness and the implicate order"; "Causality and Chance in Modern Physics".

For other reference material and a huge wealth of antiquity's (and modern) archives on the internet, try: Google Archive; Gallica of France; Gutenberg archive; Archivx science treasures, and of course, Wikipedia, the Free Encyclopedia <http://www.wikipedia.org/>. And when all else fails (in fact maybe before), there is the incredible well of knowledge that is the INTERNET. Google it!

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Sam S. Abujawdeh was born in Lebanon in 1955. He is a native of Maska, a small village in the mountains of El Metn district.

After graduating from Brummana High School (a British Quaker institution), and a short stint at the American University of Beirut, he left to the US for studies in Electrical and Nuclear Engineering at Syracuse University and the University of Cincinnati.

Sam has worked at General Electric, AT&T, and other companies in the US & worldwide, taking early retirement as Regional Vice President for Operations at Lucent Technologies in 2001. He currently contracts with AT&T & other companies in New Jersey, USA, where he lives with his wife and four Children.

